QUATERNARY VERTEBRATE FAUNAS FROM THE TEXAS CAVES OF SOUTHEASTERN QUEENSLAND

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ABSTRACT

Results of excavation in Pleistocene deposits of two of the Texas Caves on Viator Hill, southeastern Queensland, are reported. The history of the deposits is interpreted on the basis of lithology and fauna. The fossiliferous sediments of The Joint (VR-5) consist of a limestone breccia fissure-fill. The sediments in Russenden (rear) Cave (VR-14) are mainly detrital accumulations from solution pipes, but appear to have had a more complex history than the sediments of The Joint.

The Joint fauna, including twenty-four kinds of mammals, contains a greater proportion of extinct marsupials, than that of Russenden (rear) Cave. It also contains a sebecosuchian crocodile, a type of crocodile previously unknown in Australia, and thought to have become extinct throughout the world during the Tertiary, as well as a new species of *Procoptodon*, *P. texasensis* sp. nov., that may also be represented in the geographically close Pleistocene Cement Mills fauna.

The Russenden (rear) Cave fauna, with thirty-eight kinds of mammals, is more diverse than, The Joint fauna, and probably better representative of the mammal fauna living around the Texas Caves during late Pleistocene times.

Considered together, the following mammal taxa from the Texas Caves faunas are of particular interest: 1) now entirely extinct: *Zygomaturus* sp., cf. *Z. trilobus;* three *Sthenurus* spp., cf. *oreas*, cf. *atlas*, and aff. *occidentalis; Procoptodon texasensis* n. sp.; *Protemnodon brehus; P. roechus; Macropus agilis* subsp., aff. *M. a. siva; M.* sp., cf. *M. thor; M.* sp., aff. *M. altus; M. titan; Conilurus albipes; Thylacinus cynocephalus, Sarcophilus laniarius,* and possibly a species of *Antechinus;* 2) now regionally extinct from southeastern Queensland: *Dasyurus viverrinus, Isoodon obesulus, Pseudomys desertor,* and *P. novaehollandiae* (the latter two were not previously recorded from Queensland); 3) and those not presently known in southeastern Queensland to occur in the contemporary habitats present on Viator Hill: *Cercartetus nanus, Perameles nasuta, Thylogale* sp., and *Rattus lutreolus.* The remaining nineteen species would be expected to survive in the area today, although in fact only two types of kangaroo and four bats have been collected from the area despite two mammal surveys.

The faunas as a whole most closely resemble the Cement Mills fauna of southeastern Queensland. Differences between the Texas faunas and other Pleistocene Queensland faunas, such as the eastern Darling Downs, in large part apparently reflect regionally different palaeoenvironments. The Texas faunas suggest the presence of sclerophyll forest on Viator Hill, with grasslands and possibly pockets of rainforest or wet sclerophyll forest in adjacent areas.

Entrance into the most conspicuous of the Texas caves on Viator Hill, Main Cave (VR-1), is via a passage formed in part of bone breccia. For this reason, the occurrence of fossil bones in the Texas caves has probably been known by Europeans since at least 1845, when the caves were encountered by Roderick McLeod (Robinson 1978).

From then until 1973 various incidental surface collections of fossil bones were made. In February 1973, and March and October 1975, following the decision to dam Pike Creek, Queensland Museum staff undertook three expeditions to excavate and recover as much of the fossil material as possible before the caves were submerged. With the cooperation of personnel from the Geological Survey of Queensland, the Kelvin Grove College of Advanced Education, the Department of Irrigation and Water Supply, and numerous volunteers, major excavations were undertaken in

what appeared to be the two palaeontologically most important caves in the area: The Joint (VR-5) and Russenden (rear) Cave (VR-14). The results of these excavations, and a review of surface collections from other caves in the area, are presented here.

Modern mammal names, unless otherwise indicated, are used in the sense of Kirsch and Calaby 1977, or Ride 1970. Fossil species names are those used by the authors of the most recent revisions of the groups concerned. Modern mammal registration number prefixes J and JM indicate Queensland Museum collections. Fossil vertebrate numbers of the Queensland Museum are prefixed by F. Fossil vertebrates of the Australian Museum are also prefixed by F and, in order to distinguish them here, are given as F(AM). Marsupial tooth number follows Archer (1978). Accordingly, the maximum (as in some peramelids) upper dental formula is: I1, I2, I3, I4, I5, C1, P1, P2, P3 (unerupted in juveniles), M1 (an ephemeral tooth absent in the adult dentition, and the same tooth regarded as dP4 by Thomas 1888, and dP3 by Stirton 1955), M2, M3, M4, M5. Crown terminology follows Archer (1976). The way in which dental measurements have been made is shown in figures in the text. The general geology, morphology and long-term geological history of the Texas Caves are reviewed by Grimes (1978), and reference to cave names, numbers and geological features follows this work.

THE JOINT (VR-5)

GENERAL CONSIDERATIONS: The Joint is a long (about twenty-two metres), narrow (less than one metre) and tall (up to ten metres) limestone fissure in the Palaeozoic Texas Beds of the New England Fold Belt. Details of the morphology of this cave (VR-5) have been given most recently by Grimes (1978). In his Map 4 he indicates the area from which the bone breccia was collected by the Queensland Museum (see also Plate 10 of the present paper) during 1975. The exact area of earlier collections has not been recorded.

Breccia has partly filled the upper parts of the southeastern end of The Joint. This reddish variably indurated sediment contained the fossil bones collected by the Queensland Museum. In the collection area it had completely blocked The Joint and progress beyond this point was effected by wriggling through a key-hole passage formed in the breccia itself. It was the breccia surrounding this particular key-hole (another key-hole near the entrance is through massive limestone) that was removed for study. In all,

about 1·8 cubic metres were removed. Despite extensive examination, no trace of sedimentary levels was distinguished. All of the visible breccia appeared to be an amorphous mass wedged between the walls of The Joint without evidence for discrete episodes of accumulation. At the time of excavation it was noted that all bones were broken, incomplete, and showed no apparent preferred orientation. Further, after processing the breccia in the laboratory, it was evident that many large animals such as diprotodontids, crocodiles, and giant kangaroos were represented by only small fragments, despite the fact that almost two cubic metres of breccia were removed, an amount which appeared to represent about half of the bone-bearing breccia visible in the area at the time of collection. These observations suggest the following interpretation. Animals may have fallen into The Joint when it was an open fissure, smaller animals falling farther than larger animals, before coming to rest as carcases at the bottom. Some rodents evidently survived the fall because a few bones have clearly been gnawed. However, none of the bones show evidence of carnivore activity and it is extremely unlikely the cave was used as a lair. The narrow width of The Joint's massive limestone walls would not have permitted an animal the size of a diprotodontid (*Zygomaturus* is represented) to fall completely into the fissure, and large animals such as this probably wedged themselves near the surface. After either rotting or being pulled apart by carnivores, some of their bones would have fallen further down into the fissure, while others might have been pulled back to the surface. This process of selective accumulation continued until such time as the fissure filled to the surface with earth, bones and limestone fragments. Before or after it became indurated, most of this fissure fill was removed by erosion from beneath and only remnants of it now remain. The only large masses left are in the southeastern end, and even here, except at the key-hole, it does not extend to the floor of the fissure. While we worked in The Joint during February, 1975, it began to rain, and from the cataract of water that came down the walls it was easy to see how erosion could have dissolved much of the breccia fill originally cemented to these walls.

The breccia at the key-hole is not uniformly indurated. In some places it is merely a light brown poorly-cemented sediment with bones and 5–10 cm limestone cobbles. Often only 10 cm away, it is completely indurated, crystalline, and only just softer than the limestone cobbles themselves. Some of the overhanging breccia

surface is covered by a mamilary surface of soft, crystalline carbonate.

Some bones were noted on the very narrow soil floor near the breccia key-hole. From their colour and preservation, most do not appear to be erosional remnants from the overhanging breccia. The only specimen of *Sarcophilus* from The Joint (F8883, collected prior to 1973) probably came from this situation. It lacks any adherring breccia or carbonate cement, and is not of the same pale colour as the bones from the breccia.

The breccia was processed in Brisbane by breaking it into progressively smaller and smaller pieces, checking each time for signs of teeth. All of the postcranial fragments obtained were submitted to Gakashuan University for radiocarbon dating, but neither the collagen nor apatite fractions of the sample proved datable (Kigoshi, pers. comm.). The reasons for this failure to obtain a date are not clear, and it was not stated that the sample was beyond the range of radiocarbon dating, although this may in fact have been the case.

THE FAUNA FROM THE JOINT: Details of the vertebrate systematics are presented later in conjunction with the fauna from Russenden Cave. A summary only of the fauna is presented here.

Reptilia

?Sebecosuchian crocodile (F7898, Hecht and Archer 1977)

Lizard (indet.) (F8475, clearly not part of breccia, presumably younger)

Mammalia: Marsupialia

Sarcophilus laniarius (e.g. F8883, although it may be part of a younger faunal assemblage, see above)
Thylacinus cynocephalus (e.g. F8871)
Perameles nasuta (e.g. F8493)
Isoodon sp., cf. *I. obesulus* (e.g. F8382)
?Vombatus sp. (e.g. F8853)
?Zygomaturus sp. (F8240)
Aepyprymnus rufescens (F8479)
Sthenurus sp., aff. *S. occidentalis* (F8529)
S. sp., cf. *S. atlas* (e.g. F8380)
S. sp., cf. *S. oreas* (e.g. F7900)
Prodoptodon texasensis n. sp. (F7894)
Protemnodon roechus (e.g. F8238)
P. brehus (e.g. F7916)
Thylogale sp. (e.g. F7923)
Petrogale sp. (e.g. F8873)
Macropus (Prionotemnus) dorsalis (e.g. F7901)
M. (P.) sp., cf. *M. (P.) thor* (e.g. F8859)
M. (P.) sp., aff. *M. (P.) agilis siva* (F9444)
M. (Macropus) titan (e.g. F8862)
M. (Osphranter) sp., cf. *M. (O.) altus* (e.g. F8532)

Placentalia

Conilurus albipes (e.g. F8491)
Pseudomys sp. (e.g. F7989, isolated molars)
Pseudomys sp. *(P. gracilicaudatus* or *P. desertor,* F8830, clearly not part of older breccia)
Rattus sp., cf. *R. fuscipes* (e.g. F8879, probably not from older breccia)

RUSSENDEN CAVE (VR-14)

GENERAL CONSIDERATIONS: Russenden Cave (VR-2 and VR-14) was opened by members of the University of Queensland Speleological Society only as recently as 1967 (Bourke 1975). Details of its morphology have been given by Grimes (1978). Prior to 1973 incidental surface collections had been made by various people from the main chamber, entered directly by VR-2, as well as from the rear entrance chamber, entered directly by VR-14. In 1973 and 1975, the Queensland Museum concentrated attention on a small area known now (e.g. Grimes 1978, Map 7) as the Bone Chamber. It could be entered by crawling from either the main chamber or more directly by crawling from the rear entrance tunnel (VR-14). A detailed sketch map of the Bone Chamber is shown in Fig. 1.

In 1973 and March 1975 lumps of bone-bearing breccia were collected from the eastern edge of the Bone Chamber. In March 1975, two test samples of the soft sediments near the east wall were taken, from 0–20 cm, and 20–40 cm. In October 1975, the March test excavation was expanded in the eastern half of the Bone Chamber and level samples were taken as recognizable stratigraphic units. The October excavation was preceded by removal of collapsed material, called CU (Clean Up), from the excavation pit, and involved units between 0 and 20 cm from the surface. This CU sample, because it also included the UB (Upper Bone-rich) unit contained a large amount of the faunal remains recovered from the Bone Chamber. Other units (Fig. 2) were less rich in bone material and as a result are now less well-represented taxonomically than the CU (0–20 cm) interval.

STRATIGRAPHIC UNITS RECOGNIZED IN THE EXCAVATION: Figure 2 illustrates the stratigraphy of the Bone Chamber excavation. The south and west wall sections reveal the most complex stratification. Considered from the base of the excavation, the following units and samples were recognised.

Lower Red unit (LR): A compacted light brown (5YR 5/6) completely friable sediment composed
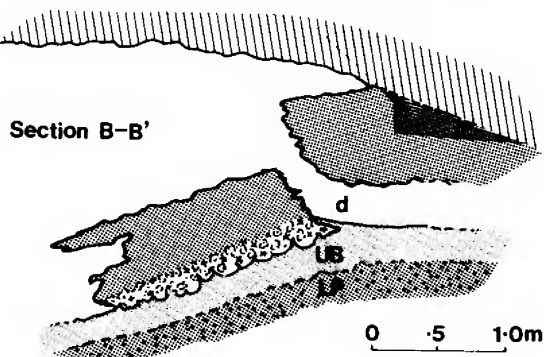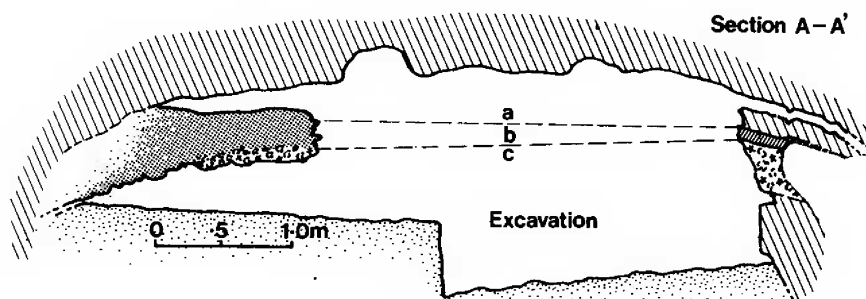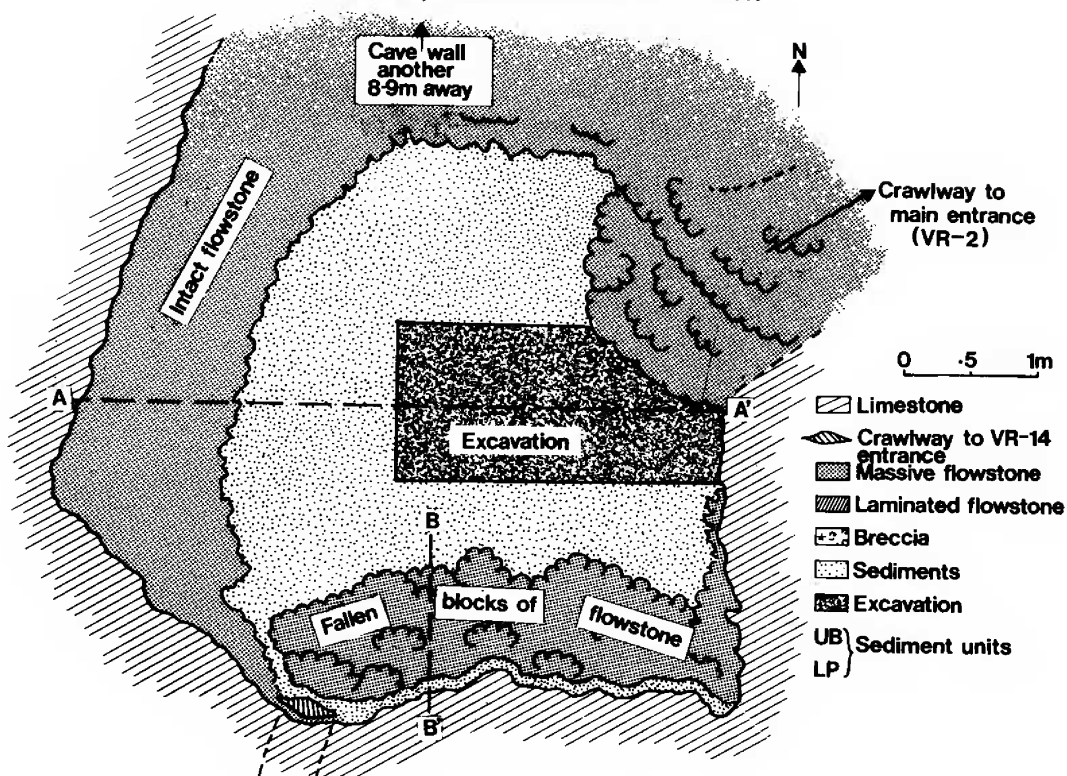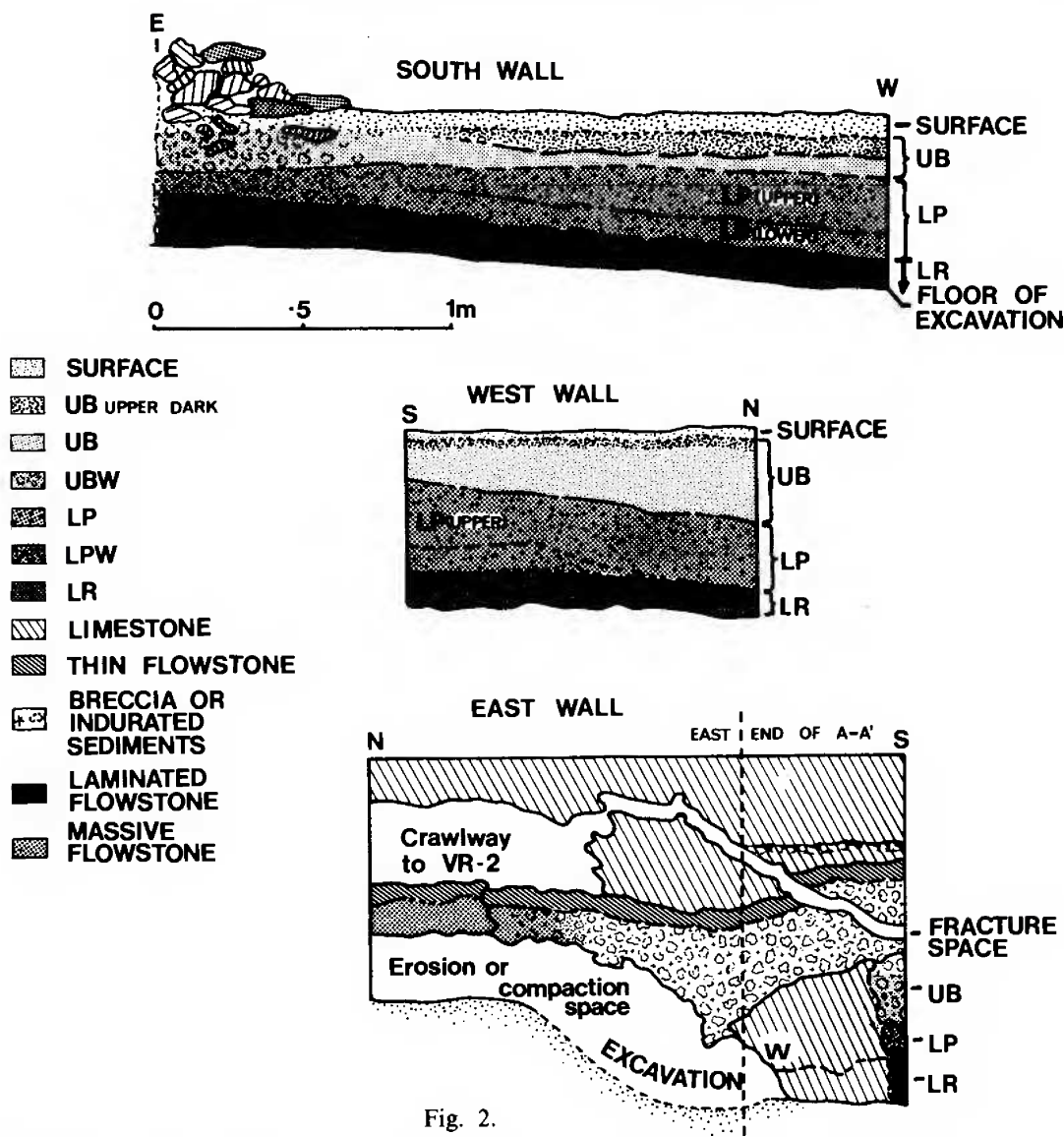
Fig. 1.

Fig. 2.

FIG. 2: South, west and east walls of the excavation in the Bone Chamber, Russenden (rear) Cave (VR-14). W indicates remnant of original tunnel wall. The vertical dashed line shown on the east wall represents the position of the east end of section A-A' of Fig. 1.

of subrounded silt to pebble-sized clay and carbonate nodules and other possibly autochthonous detritus. The carbonate nodules appear as white pebbles of irregular size. No bone was observed and there is nothing in this unit to suggest a contribution from outside the cave. The surface of this unit dips to the northwest. As far as could be determined, this unit underlies the whole of the excavation area. Its surface is not obviously eroded although the contact between it and the overlying sediments, in terms of texture and colour, is abruptly distinct. The excavation floor occurs within this unit so its thickness is unknown.

FIG. 1: Plan and sections of the Bone Chamber, Russenden (rear) Cave (from tape and compass survey, Archer and Kohout, 16 October 1975). Abbreviations not included in legend: a, interpreted former surface of flowstone across chamber; b, flowstone across chamber; c, surface of underlying sediments prior to compaction or erosion; d, fracture space adjacent to crawlway to rear entrance (VR-14).

Lower Pebbly unit (LP): A friable moderate brown (LP 5YR 3–4/4) sediment composed of angular clayrich silt to pebble-sized detritus and whitish carbonate lumps. Bone is uncommon but present in local concentrations throughout this unit. Two subunits are recognizable: a thin (maximum thickness, 10 cm) lower part (5YR 3–4/4), characterized by more angular detritus and abundant carbonate nodules, and which lenses out in a northerly direction; and a much thicker (maximum thickness, 25 cm) upper part (5YR 4/4) characterised by smaller-sized particles and few carbonate fragments. The Lower Pebbly unit thickens to the west and wedges out to the east. Its base dips to the northwest, but its top dips only to the north. Maximum thickness of the unit is 35 cm. Bone samples from the Lower Pebbly unit were not separated into upper and lower subunits at the time of collection.

Near the east end of the excavation, where the sediments abut against the cave wall, stratigraphic levels are very difficult to discern. For this reason two divisions of excavated material were made: LP, as noted above; and LPW (Lower Pebbly Wall) including only material collected within 60 cm of the cave wall and over a vertical distance equivalent to that of the LP level farther west where the position of the upper and lower boundaries are clear. The upper contact, between the Lower Pebbly unit and the Upper Bone-rich unit is gradational and recognisable mainly by a textural change, the Upper Bone-rich unit being composed of less angular particles.

A bone sample from the LP unit (not including the LPW division) was submitted from radiocarbon dating, but neither collagen nor apatite fractions were adequate (Kigoshi, pers. comm.). The reasons for this inadequacy are not clear.

Upper Bone-rich unit (UB): A friable to semi-indurated (in the southeastern corner) moderate to light brown (5YR 4–5/6) sediment composed of silt to pebble-sized particles as well as numerous small bones. The top of this unit is marked by a 1 cm thick dark band of possibly carbon-enriched sediment. The character of the Upper Bone-rich unit changes vertically from a moderate to light brown (5YR 4/6), finer, more acid-reactant, better-sorted sediment above to a light brown (5YR 5/6) coarser, less well-sorted sediment below. This change is completely gradational. The whole unit dips and thickens to the north. It is up to 25 cm thick in the northwest corner of the excavation, but as thin as 7 cm in the southwest corner. The lower contact with the

Lower Pebbly unit is gradational, and based on textural change (see above).

As was the case for the Lower Pebbly unit, the eastern 60 cm of this unit was collected separately (UBW) from the remainder and for the same reasons. Also collected as separate samples (UBP and UBPW) were bone-rich sediments filling pockets or cavities developed within the UB layer in the southeastern half of the excavation. These pockets appeared to be water erosion channels developed through the more compacted southeastern sediments, in which bones and darker more organic-rich sediment had come to rest.

A bone sample was submitted from the UB unit (not including bone from UBW) but as for all other samples submitted from the Texas Caves, neither collagen nor apatite dates could be obtained.

The surface layer: The entire Bone Chamber is covered by a variably thick (average 2 cm) layer of very fine brown silt-sized sediment which may represent dust accumulation in the gently concave surface of the chamber floor. No bone or other large detritus was collected from this layer. Contact with the underlying UB layer was not observed to be gradational.

THE BRECCIA: adjacent and cemented to the eastern wall of the Bone Chamber, is a brown carbonate cemented breccia containing some bones. It also occurs as patches cemented beneath the flowstones around the circumference of the Bone Chamber. Its relationship to the UB unit is prolematical. The eastern end of the UB unit (sample UBW) appears to be gradationally continuous with the breccia. However, in the southern and northeastern part of the excavation, where the UB unit is completely friable, this unit contains rare clasts of what appear to be the same breccia. The problem is discussed below.

INTERPRETED HISTORY: In the course of excavating the Bone Chamber, the eastern boundary wall revealed several features which enabled the older episodes of development to be interpreted. The massive limestones of the ceiling were found to curve gently down the eastern wall, forming what appears to be the very top of a broadly arched tunnel, against whose southeastern wall the excavation is developed. Tunnels of this kind are characteristic of Russenden Cave (see Grimes 1978). It seems highly probable that the Bone Chamber represents a corner in a tunnel linking the main chamber of Russenden Cave with

the now detritus-filled chamber containing Margot's Shawl.

Not considering for the moment the breccia in the bone chamber, the oldest observed sediment filling this tunnel is the Lower Red (LR) unit. It appears to contain no bone or other allochthonous detritus, and either represents a purely autochthonous cave sediment or else a highly sorted inorganic fraction of an externally derived sediment, possibly with its source in the main chamber of Russenden Cave.

The next oldest sediment is the Lower Pebbly (LP) unit. Its bones and the dip to the northwest suggest a solution pipe had broken through to the southeast admitting allochthonous materials and perhaps providing owl roosts. Most of the bones in this and the Upper Bone-rich (UB) units are of small mammals and this suggests accumulation perhaps from owl pellets. Alternatively, the entrance may have only been large enough to admit small mammals. Whatever, the present rear entrance solution pipe (VR-14) is in a highly suitable position to be the one that allowed entry of the allochthonous materials in the LP unit. The northwestern edge of the rubble pile below this solution pipe slopes off towards the Bone Chamber, and is only about two to three metres away from the excavation site.

Change from Lower Pebbly (LP) to Upper Bone-rich (UB) unit deposition was gradational. The surface of the detritus fill in the Bone Chamber was becoming horizontal but still retained a gentle northern dip, suggesting continued accumulation from the southeastern rear entrance solution pipe. Bones in the UB unit are commonly encrusted with calcium carbonate, but otherwise free in the sediments. This is true mainly in the areas of the excavation west of the eastern end. This generalization is complicated by the observation that (as noted above) the sediments of the UB unit become gradually more indurated as they approach the wall, and ultimately are difficult to distinguish from the breccia adherring to the cave wall. There are at least two possible interpretations: 1) The bones (all or some) in the UB unit were in fact derived by decalcification of an older overlying breccia, thus accounting for their encrustation. Although this is possible, it is unlikely that the hypothesized older breccia could be equivalent to the presently visible breccia in the bone chamber because this appears to be laterally equivalent to the UB unit; 2) Not all of the bones in the UB unit are encrusted and this lack appeared at the time of excavation to be a function of the distance from the edge of the Bone Chamber. This suggests that

the induration, formation of the breccia now visible, and attendant encrustation may have been a peripheral phenomenon that affected the préviously rather than subsequently deposited UB unit. Therefore the age of the bones in the UB unit and the breccia would be the same. Although this interpreatation seems reasonable, it is difficult to understand how bones isolated in the otherwise non-indurated parts of the UB unit could develop encrustations, unless they somehow acted as centres of precipitation of calcium carbonate. I had hoped that radiometric dates on bones from the breccia and other levels would contribute to an understanding of the relative ages of the various units, but as noted above, no dates could be obtained.

Some time following deposition of the UB unit, and the possibly contemporaneous sediments of the breccia, the Bone Chamber was evidently covered, at least peripherally, by laminated flowstones about 5 cm thick near the east wall, and much thicker (possibly up to 40 cm) in the northern and western parts of the Bone Chamber. These flowstones have various irregular local dips, but in general appear to dip to the southwest. Approximately two metres to the northeast of the Bone Chamber, along the squeeze passageway leading to the main chamber of Russenden Cave, is a massive flowstone cone, presumably the centre of calcium-carbonate-enriched waters responsible for flowstone deposition in the Bone Chamber. In some areas of this flowstone, notably the east wall, the base contains clayballs suggesting an erosion interval contemporaneous with the first stages of flowstone deposition. There are no interbedded detrital sediments in the flowstone squence and this, combined with a lack of bones observed in the flowstone, may indicate that the rear entrance solution pipe was blocked.

This period of flowstone deposition may have been contemporaneous with the actual carbonate induration of the breccia and some of the encrustation on bones in the UB unit noted above.

Flowstone deposition was followed by compaction or erosion of the underlying sediments. Evidence for this is twofold: There is at present a widespread space, at least about 25 cm high, under the whole of the Bone Chamber flowstones, as well as under the flowstones in the connecting tunnel leading to the main chamber of the cave; further, in the east wall of the Bone Chamber, there is a continuous five centimetre gap between the actual ceiling of the Bone Chamber and a portion of the arched roof of the original tunnel. This gap represents a subsidence of part of the

tunnel wall onto or with the accumulated sediments below. Breccia adherring to the wall is fractured and displaced across this gap. It seems probable that this wall collapse could not have occurred if all the soft sediments had remained *in situ* against the wall. However, it could have occurred contemporaneously with compaction of the sediments.

Following compaction or erosion of the underlying softer sediments, much of the then unsupported flowstone collapsed in the southern side of the Bone Chamber, bringing down with it remnants of underlying breccia. Collapse also occurred in the southeastern corner, adjacent to the excavation, contributing to the confusion of interpretation of the breccia's age by introducing lumps of the breccia into the now exposed and non-indurated top of the UB unit.

A remnant thin rim of calcium carbonate on the east wall, about 5 cm above the massive flowstone, suggests a period of ponding of calcium carbonate enriched water, perhaps as rock pools on the surface of the flowstone.

Events of unknown age in this sequence include the development of the pockets or tunnels (UBP, and UBPW samples) in the UB unit suggestive of solution tunnels. Solution tunnels (if that is what they are) of this kind must have been formed by undersaturated waters and therefore must either have predated or postdated the period of flowstone deposition rather than been a contemporaneous development. Bones in these tunnels ineed not be of the same age as the tunnels themselves. Some of these bones have a less leached and mineralized appearance than bones from the UB or LP units, and are interpreted to be younger than bones from these two units. Others, however, including an M¹ clearly representing the Pleistocene *Macropus titan*, are preserved in a manner identical to bones from the UB unit, and may represent a lag deposit following the erosion of the pockets in the UB unit.

We know that when the rear entrance (VR-14) was discovered in 1967 or 1968, the solution pipe was blocked by debris. We don't know how long ago this blockage occurred. The few bones recovered in 1973 from the surface of the large chamber below the rear entrance, adjacent to the Bone Chamber, included rabbits, but it is not inconceivable that these had accumulated since 1967–8. In view of the lack of much surface bone below this rear entrance, and its probably rather recent origins, it is concluded here that the rear entrance has been blocked since at least late Pleistocene time.

The final events presently recorded in the Bone Chamber include our excavation, in a very complicated deposit, and the entrance of the major flood waters which have entered the cave, slumped the excavation walls, and inundated all of the Russenden Cave chambers (Shannon 1977).

FAUNAS FROM THE BONE CHAMBER, RUSSENDEN CAVE: Details of the taxa enumerated here are given in the systematic section below. The lists given here are summaries of each of the samples noted above.

Lower Pebbly Unit (LP)

Marsupialia
Smithopsis murina (e.g. F8424)
Phascogale tapoatafa (F8534)
Dasyurus viverrinus (e.g. F8519)
Perameles nasuta (e.g. F8418)
Petaurus norfolcensis (F8537)
Macropus (Macropus) sp. cf. *M. (M.) giganteus* or *M. (M.)* sp. cf. *M. titan* (e.g. F8514)
M. (Osphranter) sp., cf. *M. (O.) altus* (F8512)
?*Petrogale* sp. (F8417)
Petrogale sp. (F8415)
?*Macropus dorsalis* (F8419)

Placentalia
Conilurus albipes (F9456)
Pseudomys sp., cf. *P. novaehollandiae* (e.g. F8421)

Lower Pebbly Wall (LPW)

Marsupialia
Antechinus sp., aff. *A. flavipes* (F8466)
Perameles nasuta (e.g. F8468)
Pseudocheirus peregrinus (e.g. F8413)
Aepyprymnus rufescens (e.g. F8407)

Placentalia
Conilurus albipes (e.g. F9445)
Pseudomys sp., cf. *P. novaehollandiae* (e.g. F8421)
P. gracilicaudatus or *P. desertor* (F8464)
Rattus sp., cf. *R. fuscipes* (F9446)

Upper Bone-rich Unit (UB)

Marsupialia
Petrogale sp. (e.g. F8323)
?*Sthenurus* sp. (F8317)

Placentalia
Conilurus albipes (F9457)
Pseudomys sp., cf. *P. oralis* (F9458)
Rattus sp. (F8327)

Upper Bone-rich Wall (UBW)

Amphibia
Unidentified frog (F8265)

Reptilia
Unidentified snake (F8363)
Geckonid, indet. (F8267)
?*Amphibolurus* sp. (F8342)

Mammalia: Marsupialia
Sminthopsis murina (F8344)
Antechinus sp., aff. *A. flavipes* (e.g. F8343)
Dasyurus viverrinus (e.g. F8341)
Perameles nasuta (e.g. F9447)
Acrobates pygmaeus (F8206)
?*Vombatus* sp. (e.g. F8368)
Unidentified genus (F8362)
Petrogale sp. (F8353)
Unidentified genus (F9448)
Macropus (Prionotemnus) sp., cf. *M. (P.) agilis siva* (F9449)

Placentalia
Rhinolophus megaphyllus (e.g. F8268)
?*Miniopterus schreibersii* (F9450)

Upper Bone-rich Pocket (UBP)

Marsupialia
Aepyprymnus rufescens (F8940)
?*Petrogale* sp. (F9451)

Placentalia
Rhinolophus megaphyllus (F8939)
?*Pseudomys* sp. (F8540)
Conilurus albipes (F8938)

Upper Bone-rich Pocket Wall (UBPW)

Reptilia
Unidentified ?lizard (F8432)

Marsupialia
Aepyprymnus rufescens (F8434)
Petrogale sp. (e.g. F8429)

Placentalia
Rhinolophus megaphyllus (F8433)
Conilurus albipes (e.g. F9452)
Pseudomys sp., ?*P. desertor* (F9453)

0–20 cm (also includes here CU sample, both of which are mixed samples containing mainly UB but also a small amount of LP)

Reptilia
Unidentified geckonid (e.g. F8937)
?Agamid (F8230)

Aves
Columbid (e.g. F8197)
cf. *Aegotheles* (e.g. F8311)
Alcedinid (e.g. F8200)
Turnix sp. (e.g. F8198)
Coturnix sp. (e.g. with F8311)
Passeriform, small
Passeriform, large

Mammalia: Marsupialia
Sminthopsis murina (e.g. F8220)
Antechinus sp., aff. *A. flavipes* (e.g. F8032)
Antechinus sp. (F8445)
Phascogale tapoatafa (e.g. F8285)
Dasyurus viverrinus (e.g. F8042)
Perameles nasuta (e.g. F8310)
Isoodon obesulus (e.g. F8280)
Petaurus breviceps (e.g. F8205)
P. norfolcensis (e.g. F8202)
Pseudocheirus peregimus (e.g. F8208)
Trichosurus sp., cf. *T. vulpecula* (F8898)
Cercartetus nanus (e.g. F8207)
?*Vombatus* sp., cf. *ursinus* (e.g. F8234)
Aepyprymnus rufescens (e.g. F8331)
Sthenurus sp., cf. *oreas* (F8307)
Protemnodon sp., cf. *P. brehus* (F8154)
?*Thylogale* sp. (e.g. F8172)
Petrogale sp. (e.g. F8196)
Macropus (Prionotemnus) sp., cf. *M. (P.) agilis siva* (e.g. F8293)
M. (Osphranter) sp., cf. *M. (O.) robustus* (e.g. F8161)
M. (Macropus) sp., cf. *M. (M.) titan* (F8899)
M. (M.) sp., cf. *M. (M.) giganteus* (F8304)

Placentalia
Nyctophilus timoriensis (F8141)
Rhinolophus megaphyllus (e.g. F8145)
Miniopteris schreibersii (e.g. F8152)
Conilurus albipes (e.g. F8528)
Pseudomys sp., cf. *P. oralis* (e.g. F8507)
P. sp., cf. *P. desertor* (e.g. F8120)
Rattus sp., cf. *R. lutreolus* (F8854)

OTHER TEXAS DEPOSITS

The foregoing lists of faunas are the result of systematic excavation. The following sites and specimens were obtained as incidental collections made by various people since 1969.

RUSSENDEN CAVE: A partial skull of *Protemnodon roechus* (F6132, Plate 9, A–B, collected D. Gillieson, 1969) was collected from the entrance rubble pile below the rear entrance (VR-14) solution pipe. This area contains flowstones and cemented rubble, and is the probable point of accumulation for most of the bones found in the Bone Chamber.

The large chamber leading off directly from the solution pipe from VR-14 has a horizontal earth floor. Bones were rare on the surface of this chamber but included the following taxa (collected by J. Covacevich, 1970, and M. and E. Archer, 1973): *Oryctolagus cuniculus*, F8449; ?*Petrogale*, F8451; a lizard, F8454; and *Rattus*, cf. *R. rattus*, F9454.

A narrow by-pass dig leading from the rear entrance (VR-14) rubble pile towards the Bone

Chamber produced an isolated lower canine of *Sarcophilus harrisii* (F9455, collected D. Gillieson, 1969).

The main entrance (VR-2) of Russenden Cave leads to a large chamber from which some bone material was collected (J. Covacevich, 1970; H. Godthelp, 1975): *Petrogale* sp. (e.g. F8895); *Aepyprymnus rufescens* (F8909); a rodent (F8902); *Rhinolophus megaphyllus* (F8906); and a frog (F8905). The frog, *Rhinolophus* and one of the *Petrogale* (F8903) specimens appear to be 'modern' and unlike the preservation of older bones from the Bone Chamber. The *Petrogale* specimen F8895 was cemented into flowstones in the southwestern corner of the main chamber, at the entrance to the tunnel that leads to the Bone Chamber.

RABSCUTTLE HOLE (VR-20): Specimens from the surface of Rabscuttle Hole (collected A. Burrows, 1975) include the following: *Pseudomys gracilicaudatus* (e.g. F8926); *Rattus* sp. (e.g. F9459); *Petrogale* sp. (F8924); *Trichosurus vulpecula* (e.g. F8914); *Oryctolagus cuniculus* (e.g. F8931); an elapid snake (e.g. F8927); and lizards (e.g. F8932) have a modern appearance and lack any carbonate encrustation. However, specimens referable to *?Pseudomys* sp. (e.g. F8855), and *Petrogale* sp. (e.g. F8929) have a carbonate encrustation and may be older.

MAIN VIATOR CAVE (VR-1): One specimen (F8500) was collected and this appears to represent a small *Petrogale*-sized kangaroo.

BEVANS POT (VR-4): Forty specimens (e.g. F8893) of *Petrogale* sp. were collected from the surface of this cave. Their preservation is consistent with interpretation of their age as modern. They were probably accumulated within historic times.

CRYSTAL CAVE (VR-3): Specimens (collected by P. Jell and J. Covacevich, 1970) collected from the surface of this cave include the following: *Petrogale* sp. (e.g. F9460); *Oryctolagus cuniculus* (F9461); and *Ovis aries*. All have a modern appearance.

SYSTEMATICS

CLASS AMPHIBIA

F8265, from the UBW sample of the Russenden Bone Chamber, contains various unidentified frog bones. There are many frogs living in the area today (Czechura, in Archer 1978), including some which are known to frequent various Texas caves such as *Litoria lesueuri*.

CLASS REPTILIA
ORDER CROCODILIA
SUBORDER SEBECOSUCHIA

F7898, a left maxillary of a crocodilian from The Joint breccia, appears to represent a sebecosuchian crocodile (Hecht and Archer 1977), and as such is one of the most important specimens recovered from this deposit. An isolated tooth (F8383), not noted by Hecht and Archer (1977), may be also referable to this taxon. Previously, except for a tentative reference of isolated teeth from the Pliocene Awe fauna from New Guinea (Plane 1967), this group of crocodiles was thought to have become extinct throughout the world during middle Tertiary time. It also is important in representing in Australia yet another group with a Gondwanaland distribution.

The question of how it came to be in the cave is equally interesting. Grimes (1978) has indicated that the flood plain of Pike Creek was formerly higher than it is now, and probably extended higher up the flank of Viator Hill. The Joint is near the top of this hill, and may have been more easily accessible to a crocodile living in the ancestral Pike Creek than it would be today.

Hecht and Archer (1977) note other previously undocumented Australian Tertitiary specimens evidently referable to the Sebecosuchia, some from Pliocene deposits of northeastern South Australia (the Palankarinna fauna). These records combined with The Joint specimens, suggest that the group was widespread on the Australian continent. However, its apparent absence from other Pleistocene deposits in Australia suggests either that they were very rare crocodiles, or that they in fact only survived this late in the Texas area of southeastern Queensland. At the moment I favour the former interpretation, particularly in view of the fact that the Pleistocene record of northern Australia is very poorly known.

ORDER SQUAMATA
SUBORDER OPHIDIA

Snakes are represented by isolated vertebrae (e.g. F8363, in the UBW sample of the Bone Chamber) but have not yet been identified. None appear to be referable to large boids such as have been reported from several Pleistocene cave deposits (e.g. Smith 1976, Archer 1972).

SUBORDER LACERTILIA

None of the numerous lizard fossils have been identified, mainly because of the awesome incompleteness of modern comparative skeletal collections. However, it is clear that at least

several families are represented, including gekonids, agamids, and probably varanids. The modern lizard fauna of the Texas Caves area is very diverse (Czechura, in Archer 1978), and many live in and around the limestone cave entrances.

CLASS AVES

The fossil birds from the Texas Caves faunas are under study by P. Rich. Provisional identifications based on tarsometatarsi and humeri are noted above for birds in the CU sample. Two of the genera represented *(Turnix* and *Coturnix,* Button Quails and Quails respectively) have not been recorded for the modern bird fauna of the area (Archer 1978c), but this omission from the modern fauna is likely to be based merely on oversight (G. Ingram, pers. comm.).

CLASS MAMMALIA
SUBCLASS MARSUPIALIA
FAMILY DASYURIDAE

Sminthopsis murina (Waterhouse)
(Plate 7A)

This small dunnart was reasonably abundant from the top to the bottom of the excavation in the Bone Chamber. I cannot find any features in

which these Russenden specimens differ from those of modern *Sminthopsis murina,* the systematics and characters of which have been reviewed most recently by Archer (in press). It has been identified here by the transverse orientation of the metacristids and hypocristids, the small to absent entoconids, closely spaced premolars, and size. A statistical summary of the measurements of all Bone Chamber specimens is given in Table 1. Methods of taking these measurements on small dasyurids have been described elsewhere (e.g. Archer 1976).

It is not known if *Sminthopsis murina* occurs in this area today although it is known from Mt. Tamborine. The habitats recorded for this species vary from swamps to dry woodlands, habitats still present around Viator Hill.

TABLE 1: MEASUREMENTS OF *Sminthopsis murina* FROM THE RUSSENDEN (REAR) CAVE DEPOSITS

Parameter	I_1–M_5	C_1–M_5	M_2–M_4	M_2–M_5	M^2–M^4	M^2–M^5
$\bar{x}$	10·4	10·4	4·4	5·8	4·8	5·4
N.	5	1	10	9	1	1
O.R.	10·0–	10·4	4·1–	5·3–	4·8	5·4
	10·9	—	4·7	6·3	—	—
S	0·34	—	0·18	0·30	—	—
C.V.	3·30	—	4·13	5·07	—	—

TABLE 2: MEASUREMENTS OF LOWER TEETH OF MODERN MALE *Antechinus flavipes* FROM NORTHEASTERN AND SOUTHEASTERN QUEENSLAND, AND THE FOSSIL *Antechinus* SPECIMENS (LEFT DENTARIES ONLY). L = LENGTH; W = WIDTH (SEE FIG. 3).

Parameter		P_2L	P_2W	M_2L	M_2W	M_3L	M_3W	M_4L	M_4W	M_5L	M_5W	M_2–M_4
	$\bar{x}$	0·14	0·09	0·18	0·11	0·22	0·14	0·23	0·14	0·21	0·13	0·61
Modern	N.	11	11	11	11	11	11	11	11	11	11	11
southeastern												
Queensland	O.R.	0·13–	0·08–	0·17–	0·10–	0·21–	0·13–	0·21–	0·14–	0·18–	0·12–	0·56–
males		0·15	0·10	0·21	0·12	0·24	0·14	0·24	0·15	0·22	0·13	0·64
	S	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·02
	C.V.	5·73	7·41	6·11	4·94	4·16	4·94	4·08	3·27	5·84	3·16	4·04
	$\bar{x}$	0·13	0·09	0·18	0·11	0·23	0·14	0·23	0·15	0·20	0·12	0·62
Modern	N.	8	8	9	9	9	9	9	9	9	9	9
northeastern												
Queensland	O.R.	0·12–	0·08–	0·17–	0·10–	0·21–	0·13–	0·22–	0·13–	0·19–	0·11–	0·58–
males		0·15	0·10	0·20	0·12	0·23	0·15	0·24	0·16	0·22	0·14	0·67
	S	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·03
	C.V.	6·69	10·29	5·50	4·55	3·42	7·05	2·60	7·77	6·12	8·11	5·36
	$\bar{x}$	0·14	0·09	0·19	0·12	0·24	0·15	0·23	0·15	0·21	0·13	0·62
Fossil Bone	N.	2	2	5	5	6	6	6	6	6	6	4
Chamber												
(less F8445)	O.R.	0·14–	0·09–	0·18–	0·12–	0·23–	0·14–	0·20–	0·18–	0·24–	0·13–	0·60–
			0·10	0·21	0·13	0·27	0·15	0·26	0·20	0·25		0·68
	S	0·00	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·00	0·02
	C.V.	0·00	0·01	6·79	4·42	3·56	3·78	6·45	3·37	2·50	0·00	2·74
F8445		0·14	0·10	0·21	0·13	0·27	0·17	0·26	0·17	0·21	0·13	0·68

Antechinus sp., aff. **A. flavipes** (Waterhouse)
(Plate 7B)

Specimens referred here to *Antechinus flavipes* have come only from the sediments of the Bone Chamber. Reference of all specimens to *A. flavipes* has been made with considerable reservation. Identification has been based on the crowded P_3, short and wide premolars, two-rooted but reduced P_3, small entoconids, low but distinct paraconid on M_2, and size. Although some specimens (e.g. F8343) are in most respects indistinguishable from modern *A. flavipes,* others are strikingly unlike any modern specimens. In particular, F8445, from the CU sample, is outside the range of any modern *A. flavipes* specimens measured, in many dental features (combined length of $M_{2\ 4}$; length and width of M_4; length and width of M_3; and width of M_2). In addition, it is outstanding in its proportionately short premolar row and bulbous crown bases, features which seem to be extraordinary developments of normal *A. flavipes* tendencies.

Apart from F8445, (Plate 7C-C'), the entire Bone Chamber *Antechinus* sample also seems to be on the average larger in some dental features than modern *A. flavipes* from southeastern Queensland. Seen in this context, it could be suggested that F8445 represents the extreme in large size in an overall larger-sized population. Table 2 is a comparison of the Bone Chamber specimens (using only left dentaries, measurements as shown in Fig. 3) with modern male specimens of *A. flavipes* from southeastern and northeastern Queensland. The sexes of the Bone Chamber specimens are of course unknown but using all male modern specimens for comparison means that the relatively large size of the Bone Chamber individuals cannot be due simply to a predominance in that sample of males. It may be noted that on the average, north Queensland *A. flavipes* are larger than those from southeastern Queensland, and in this respect, more closely approximate the size of all of the Bone Chamber individuals except F8445, which is still outside the range of modern variation in the characters noted above.

I have compared F8445 with all known species of *Antechinus,* as well as related genera such as *Phascogale* (*P. calura* is very *Antechinus*-like in dental morphology) and am satisfied that it cannot be referred to any known species, unless to *A. flavipes.* More detailed systematic work on this thin-tailed group of Antechinuses is required, however, before the Bone Chamber specimens,

and F8445, in particular, can be confidently allocated to or separated from *A. flavipes.*

There is no evidence for believing *Antechinus flavipes* occurred within the Texas Caves area in Recent times, although it does occur as far west in southwestern Queensland as Chinchilla on the western edge of the Darling Downs, and as close as Wallangarra. It lives in a variety of habitats from swamps to dry sclerophyll woodland, a habitat which is still present today on Viator Hill.

Phascogale tapoatafa (Meyer)
(Plate 7D)

Only four very fragmentary Bone Chamber specimens represent this distinctive dasyurid. The only specimen measured (F8534) is as follows: LM^2 (in a maxillary fragment with P^{2-3}) buccal length, 3·8; maximum width from the outside
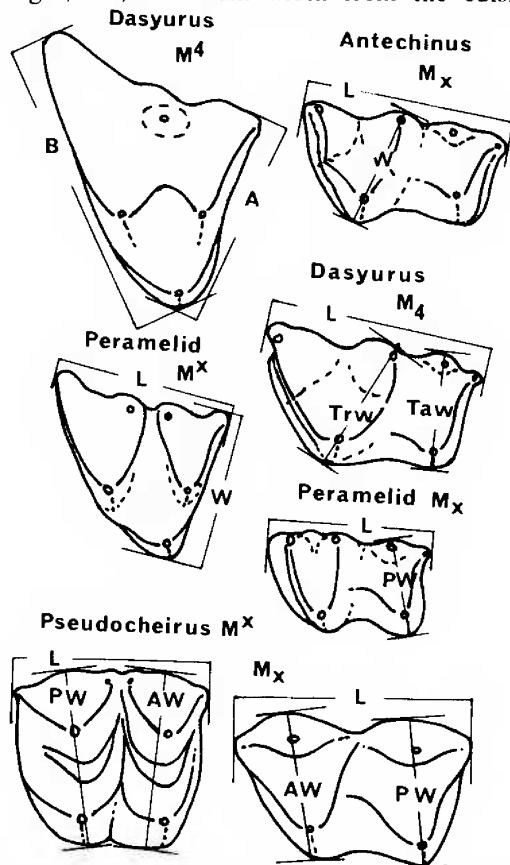

FIG. 3: Right upper and left lower molars of *Dasyurus, Antechinus,* a peramelid, and *Pseudocheirus* to show positions from which measurements were obtained (for these taxa only). Terminology of widths is that used in the Tables and relevant sections of the text. Figures are not drawn to the same scale.

flanks of the protocone to the metastylar corner of the tooth, 4·0. The size of the Bone Chamber specimens is consistant with that of modern southeastern Queensland specimens (e.g. J4695).

Living *Phascogale tapoatafa* are always uncommon. For this reason, their relative rarity in the Bone Chamber deposits is not surprising. The preferred habitat in southeastern Queensland appears to be wet or dry sclerophyll forest, and pockets of the latter still occur on Viator Hill. Specimens of living animals have come from as close as Woodenbong.

Dasyurus viverrinus (Shaw)
(Plate 7E)

Native cats are represented by very fragmentary specimens from the Bone Chamber. There is some doubt about the specific identity of this material. At present three living species of *Dasyurus* have been recorded from Queensland: *D. maculatus*, which is still living around the Texas area; *D. hallucatus* which once occurred as far south as Gympie (Ride 1970); and *D. geoffroii* which evidently occurred in the arid southwestern areas of the State. In addition, Bartholomai (1971) has described an extinct Pliocene species,

D. dunmalli from the Chinchilla Sand, southeastern Queensland, and simultaneously referred (but without detailed analysis) specimens from the Pleistocene eastern Darling Downs deposits to *D. viverrinus,* and from the Pleistocene Cement Mills fauna (Bartholomai 1977) to *D.* aff. *D. viverrinus.* Distinguishing *D. maculatus* and *D. hallucatus* from other species and the Bone Chamber specimens on the basis of size and molar morphology is not difficult. Similarly, *D. dunmalli* is unique in having a single-rooted P_3, and unlike the Bone Chamber specimens (F8341, F8443, F8409 and F8283) in which the $P^2 - M_2$ region is preserved. This leaves *D. geoffroii* and *D. viverrinus,* which in terms of molar morphology and size are very similar.

Smith (1972) suggests that the upper fourth molars ($= M^3$ of Smith) of these species may be distinguished by a ratio of protocone-parastyle to protocone-metastyle lengths. Table 3 is a comparison of Queensland Museum specimens of *Dasyurus geoffroii* and *D. viverrinus* for these characters (see Fig. 3) and they clearly support Smith's suggestion. On this basis, the only M^4 from the Bone Chamber, F8042, is referable to *D. viverrinus.*

Marshall (1973) regards the M_4 ($= M_3$ of Marshall) of *Dasyurus geoffroii* to differ from

TABLE 3: M^4 IN *Dasyurus geoffroii, D. viverrinus,* AND THE TEXAS SPECIMEN F8042.

Species	D. geoffroii (W.A.)			D. viverrinus (?Tas.)			F8042		
Parameter	A (Pr. to past. M^4)	B (Pr. to metast. M^4)	A/B	A	B	A/B	A	B	A/B
$\bar{x}$	4·9	6·6	0·75	4·3	6·5	0·67	4·0	6·6	0·66
N.	2	2	2	9	9	9	1	1	1
O.R.	4·7– 5·1	6·4– 6·7	0·73– 0·76	3·8– 4·7	6·1– 6·8	0·59– 0·74	—	—	—
S	0·28	0·21	0·02	0·35	0·24	0·05	—	—	—
C.V.	5·77	3·24	2·55	8·08	3·69	8·26	—	—	—

TABLE: M_4 IN *Dasyurus geoffroii, D. viverrinus* AND THE TEXAS CAVES SPECIMENS
(TRW = TRIGONID WIDTH; TAW = TALONID WIDTH)

Species	D. geoffroii (W.A.)				D. viverrinus (?Tas.)				Texas specimens			
Parameter	A (M_4L)	B (M_4 TrW)	C (M_4 TaW)	B/A	A	B	C	B/A	A	B	C	B/A
$\bar{x}$	5·6	3·4	3·0	0·61	5·3	3·3	3·0	3·0	5·4	3·1	2·8	0·57
N.	9	9	9	9	8	8	8	8	2	2	2	3
O.R.	5·1– 6·0	3·0– 3·7	2·6– 3·3	0·56– 0·67	5·0– 5·6	2·9– 3·5	2·6– 3·2	0·57– 0·65	5·3– 5·5	3·1– 3·2	2·8–	0·57– 0·58
S	0·35	0·27	0·24	0·04	0·23	0·19	0·20	0·03	—	—	—	—
C.V.	6·27	7·83	8·08	6·05	4·39	6·02	6·78	4·68 ·	—	—	—	—

that tooth in *D. viverrinus* in being relatively narrower (compared to the tooth's length), in having the talonid narrower than the trigonid (it is supposedly as wide as the trigonid in *D. viverrinus)*, and in having the protoconid in a slightly more anterior position relative to the metaconid. The last character is not accessible in isolated teeth because it depends on orientation of the crown. In any case, P. Crabb (pers. comm.), having more extensively examined Marshall's material, suggests this character is subject to variation. Table 4 compares the other two characters for Queensland Museum specimens of both species, as well as cave surface specimens of *D. geoffroii* from southwestern Western Australia. It is clear that although the M_4 trigonids of *D. geoffroii* are on the average slightly larger than those of *D. viverrinus*, the trigonids of the latter

are consistantly wider than the talonids, supposedly a condition lacking in *D. viverrinus*. Similarly, the ratio of M_4 crown length to trigonid width clearly does not distinguish the two species based on at least the present sample. For these reasons, Marshall's (1973) characters have not been found useful in determining the specific identity of the Bone Chamber specimens.

Confirmation of Smith's (1972) diagnostic characters with the Queensland Museum's modern specimens have been the basis for determining F8042 as *Dasyurus viverrinus*. There is at present no reason for believing any of the other Bone Chamber specimens are referable to *D. geoffroii*, and all are accordingly tentatively referred to *D. viverrinus*.

Dasyurus viverrinus could almost certainly survive in the dry sclerophyll forest of the Viator
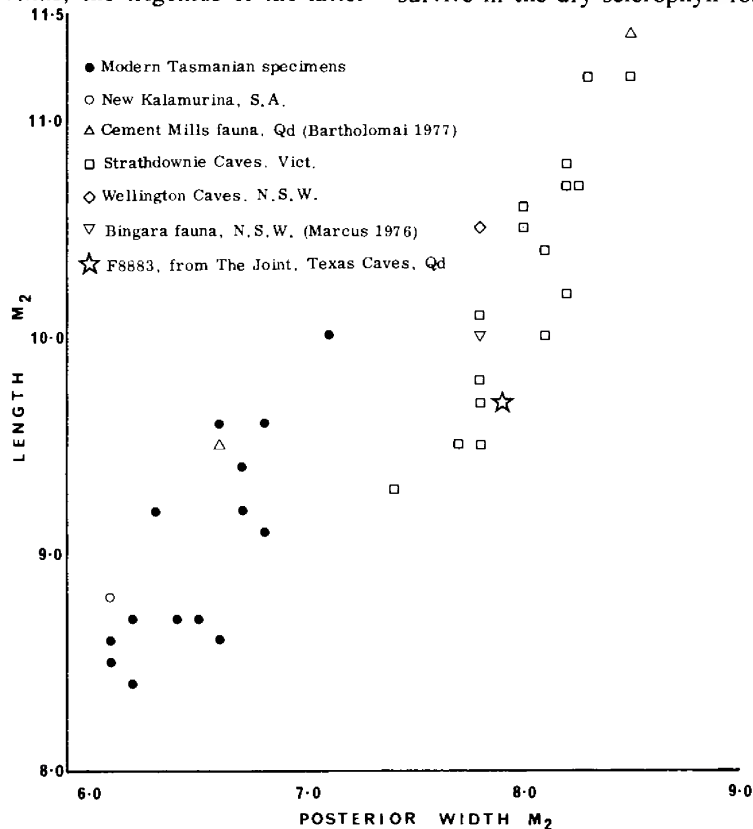

FIG. 4: Comparison of the M_2 (length vs maximum transverse talonid width) of modern Tasmanian and various fossil samples of *Sarcophilus*. The larger cluster includes material from Wellington Caves, the type locality of *laniarius*. The smaller cluster includes modern *S. harrisii*. Of particular note are the Cement Mills specimens, one of which is decidedly part of the larger *laniarius*-cluster, while the other falls into the *harrisii*-cluster. The Texas specimen (F8883) falls into the lower range of the *laniarius*-cluster and as a result has been referred here to *S. laniarius*.

Hill area today and the reasons for its apparent extinction from southeastern Queensland are not understood. It has similarly become extinct in South Australia (Smith 1972). Troughton (1967) suggests the species was decimated by some form of epidemic disease in 1901–3 at which time it suffered an extensive reduction of range.

Sarcophilus laniarius (Owen)
(Plate 7F)

Two specimens, F8883 from The Joint, and F9455 from the by-pass dig between the entrance chamber and the Bone Chamber of Russenden (rear) Cave (VR-14), appear to represent this large dasyurid. The Joint specimen, collected by A. Bartholomai, a left dentary fragment preserving M_2 and alveoli for I_{1-3}, C_1, P_1, M_3, and roots of P_2, is not preserved in the manner of other bones collected from the breccia, and it may represent a younger fauna than that of The Joint breccia. The Russenden specimen, collected by D. Gillieson in 1969, is preserved in a fashion comparable with bones from the UB and LP samples. The size of the M_2 of F8883 is as follows: M_2L, 9·7; M_2 trigonid width, 6·6; M_2 talonid width, 7·9.

Measurements of F8883 were plotted (Fig. 4) with those of other M_2s of fossil *Sarcophilis* from Strathdownie (National Museum of Victoria), Wellington Caves, Gore (Cement Mills fauna), Bingara, and New Kalamurina, and modern *Sarcophilus* from Tasmania. Two clusters are apparent, one including F8883, the Strathdownie, Wellington, and Bingara specimens, and the other including specimens from New Kalamurina and modern Tasmania. The type specimens of *laniarius* come from Wellington Caves, and if the larger cluster in Fig. 4 is to receive taxonomic distinction (and this question is entirely unsettled), *laniarius* is the available name. The smaller cluster includes all measured modern *Sarcophilus* from Tasmania and would be called *harrisii*. The Gore specimens present an interesting problem. Bartholomai (1977), in the description of the Cement Mills fauna, refers these to *S. laniarius*, but this examination suggests that two distinctive populations are included in the sample: one, including only F3734 and F3725, is very large and may be referable to *laniarius*; the other is comparable to modern *harrisii* in dental size and includes all of the other specimens. This supports the previous suggestion by Bartholomai (1977) on the basis of such evidence as the presence in the sample of both *Palorchestes parvus* and *P. azael*, that the Gore

sample may represent a mixture of different aged faunas.

The Russenden canine (F9455) has not been allocated to either the *harrisii* or *laniarius* group of specimens, because it has not yet been demonstrated that lower canines of *Sarcophilus* fall into two groups comparably distinct as those for the lower M_2. Tentatively it has been referred to *S. laniarius*.

The living species *Sarcophilus harrisii* once occurred throughout much of Australia (Archer 1978a) and has been recorded from the Australian mainland in deposits dated as recently as 430 ± 160 years BP (Archer and Baynes 1972). Specimens referred to *laniarius* have come from many Pleistocene deposits in Australia, but most of these are inadequately dated. Marshall (1973) records *S. laniarius* from the late Pleistocene Frenchman's Creek and late Pleistocene-Holocene Lake Victoria faunas, New South Wales. P. Crabb (pers. comm.) is presently studying material from the early Pleistocene Lake Victoria region that appears to be referable to *Sarcophilus*, but possibly a species ancestral to the *laniarius-harrisii* group. This would suggest that *laniarius* may only range from early to late Pleistocene in age.

FAMILY THYLACINIDAE

Thylacinus cynocephalus (Harris)
(Plate 7G)

A single isolated left M_3 from The Joint represents this modern species. The measurements of the tooth are as follows: length, 12·8; trigonid width, 6·2; talonid width, 6·8. They are consistant with interpretation of the tooth as *Thylacinus cynocephalus* (e.g. see Ride 1964). All features of the tooth compare well with modern specimens, such as J13681, except for the tooth's slightly better-developed posterobuccal cingulum.

Elsewhere (Archer 1974, and more recently Milham and Thompson 1976), a case has been made for the extinction of the Thylacine on the Australian mainland following the appearance of the Dingo. The absence of Dingo remains from both The Joint breccia and all of the Russenden Bone Chamber samples suggests that both deposits probably predate the appearance of the Dingo, possibly about 4000 years BP. The oldest reliably dated Dingo remains (Milham and Thompson 1976) are from a Nullarbor cave deposit dated at 3,450 ± 95 years BP.

The distribution of the Thylacine included all states of Australia, and Papua New Guinea, and

its presence in The Joint breccia is by no means unexpected.

FAMILY PERAMELIDAE

Differentiation of peramelid species using fragmentary dental remains only is frought with uncertainty, and conclusions reached now about recognition of distinctive dental features very likely will be found inadequate once a comprehensive continental wide analysis is made of all species. The Texas peramelid specimens have been compared with all known genera, but not all species of *Isoodon* or *Perameles*. Two genera have been recognized, *Perameles* and *Isoodon,* on the basis of: 1) angle of recline of the ascending ramus (much lower in *Perameles*); 2) height of the anterior cingulum of the lower molars and distance between its anterolingual end and the paraconid tip (generally cingulum lower and more distant in *Perameles*); 3) development of the hypocone (smaller in *Perameles*); 4) length of the postmetacrista (longer in *Perameles,* particularly on M^4); 5) shape of the protocone root alveolus (simple, smaller, and oval in *Perameles,* dumb-bell or bilobed outline in *Isoodon*); and 6) length of the maxillary vacuities (longer in *Perameles*). Some of these features (1, 3) are noted by Merrilees (1967) and others (1, 2, 3, 5) by Smith (1972). Methods of taking measurements are shown in Fig. 3.

Perameles nasuta Geoffroy
(Plate 7H)

At least twenty-four specimens appear to represent *Perameles nasuta.* They have been referred to this species because they cannot obviously be distinguished from this species and they lack the characters of *P. bougainville, P. gunnii,* and *P. eremiana* reviewed by Smith (1972). *P. nasuta* is also biogeographically the closest species of living *Perameles* to the Texas Caves area. Specimens are known from Cunningham's Gap.

The Joint specimens representing *P. nasuta* include only four isolated teeth as follows: F8493, M^4L, 4·0; M^4W, 3·5; F7914, M_2L, 3·9; M_2PW, 2·5; F8530, broken left lower molar; and F7985, trigonid of an M_2.

The Bone Chamber specimens are more numerous, but few included measurable cheek-teeth. The following measurements are based on various different teeth (details are on data sheets lodged in the Queensland Museum library): M_{2-4}, 12·0; M_2L, 3·3; M_2PW, 2·2; M_5L, 4·7; P^3L, 3·6; P^3W, 2·3; M^2L, 4·5 and 4·4; M^2W. 3·5; M^3L, 4·5 and 4·3; M^3W, 4·1.

Perameles nasuta today commonly occupies rainforest and wet sclerophyll forest in south-eastern Queensland, but also extends into drier habitats. For this reason, it is evidently not a good palaeoenvironmental indicator.

Isoodon obesulus (Shaw)
(Plate 7I)

The Joint and Bone Chamber deposits contain a poorly-represented small species of *Isoodon,* which in terms of size, is distinguishable from the larger *I. macrourus.* Confusion could possibly occur with *I. auratus* but in the Texas specimens in which the ascending ramus is preserved, the angle of ascension is consistant with specimens of *I. obesulus* and not *I. auratus* (G. Gordon, pers. comm.).

Measurements (all Bone Chamber specimens) are as follows: F8284, M_2L, 3·5; M_3L, 3·8; M_4L, 4·0; M_5L, 4·1; F8280, M_3L, 3·9; F8081-2 (one specimen), M_2L, 3·2; M_3L, 3·6; M_4L, 3·5, C_1-M_4, 21·6; M_{2-4}, 10·0; F8086 M^2L, 3·3; M^2W, 2·7; M^3L, 3·5; M^3W, 3·0; M^4L, 3·3; M^4W, 3·2; M^{2-4}, 9·3.

Living *Isoodon obesulus* has not been recorded from coastal southeastern Queensland, where the common peramelid is *I. macrourus. I. obesulus* has also been identified (Archer, Van Dyke and Beaton, in preparation) from archaeological shelter sites in the Carnarvon Ranges of southeastern central Queensland. Bartholomai (1977) reports *Isoodon* sp. from the Pleistocene Cement Mills fauna of southeastern Queensland, regarding it to be smaller than any Queensland Museum specimens, and, on the basis of its small size, possibly distinct from known species. Modern comparative specimens from southeastern Queensland, previously identified as *I. obesulus* in the mammal collections of the Queensland Museum, all evidently represent the larger species *I. macrourus* (G. Lyne and G. Gordon, pers. comms.). The Cement Mills specimens are clearly smaller than these, but not significantly different in size from Texas fossil specimens or modern Western Australian specimens of *I. obesulus.* The Cement Mills and Texas faunas are evidently the only ones in Queensland in which occur both *I. obesulus* and *P. nasuta.*

Isoodon obesulus in other states of Australia appears to favour woodland and sclerophyll forest habitats, both of which still occur on Viator Hill.

VOMBATIDAE

Vombatus sp., cf. V. ursinus (Shaw)

Wombat remains from The Joint and Russenden (rear) Cave deposits represent a species of *Vombatus* (E. Wilkinson, pers. comm.), based on the combination of grooved upper premolars and V-shaped inter-lobe valleys of the molars. Most specimens however consist only of fragments of isolated molars, and are at present unidentifiable. The more complete specimens (e.g. F8531) are under study by E. Wilkinson. He suggests (pers. comm.) that they probably represent *hirsutus (hirsutus* being at least a race of *ursinus;* it was included within that species by Ride 1970).

Vombatus ursinus occurs today as close to Texas as Stanthorpe, southeastern Queensland, in dry sclerophyll forest.

DIPROTODONTIDAE

?Zygomaturus sp., cf. Z. trilobus Owen
(Plate 7P)

F8240, a fragment of a very large molar, is indistinguishable from the lingual half of the hypoloph of M^3 of *Zygomaturus trilobus*. The enamel is smooth, without the common punctate appearance of *Diprotodon,* and the part of the loph preserved is uncurved, the curved condition being normal for *Nototherium*. Because of the very fragmentary nature of this specimen, this identification can only be regarded as tentative.

Zygomaturus trilobus occurs in Pleistocene deposits across the continent. Recently collected specimens even demonstrate it was present in northern Australia. There seems little reason to doubt that it was a large terrestrial browsing marsupial and thus probably could not have survived in rainforest.

Its size would also make movement in dense forest of any kind difficult. The probable habitat would be open woodland with an understorey of shrubs.

BURRAMYIDAE

Cercartetus nanus (Desmarest)
(Plate 7J)

Three dentaries, from the 0–20 cm sample of the Bone Chamber, represent this pigmy possum. Two of the specimens, F8207 and F8209 are virtually identical to J13580 from the forests of the Lamington Plateau, southeastern Queensland, and in dental characters, conform only to *C. nanus*

(e.g. see Turnbull and Schram 1973). The third, F9462, has a somewhat larger dentary, but lacking teeth, the possibility that it might be different cannot be checked. Tentatively all three specimens are assumed to represent *Cercartetus nanus*.

Measurements are as follows: F8207, $P_1 - M_4$ (alveolar distance), 6·3; M_{2-4} (alveolar distance), 4·3; M_2L, 1·6; M_2W, 1·1; M_3L, 1·4; M_3W, 1·1; F8209, M_{2-4} (alveolar distance), 4·3; M_2L, 1·5; M_2W, 1·0; F9462, $P_1–M_4$ (alveolar distance), 6·2; and M_{2-4} (alveolar distance), 3·4.

Cercartetus nanus is very rare in Queensland's modern fauna, being only known from the Lamington Plateua of southeastern Queensland. It occurs in dry and wet sclerophyll forests of the southern states and it could probably still survive on Viator Hill.

Acrobates pygmaeus (Shaw)
(Plate 7K)

One specimen, F8206, represents this distinctive Feather-tailed Glider, from the Bone Chamber.

Measurements are as follows: condyle of dentary to posterior edge of I_1 alveolus 12·3; posterior edge of I_1 alveolus to posterior edge of M_4 alveolus, 5·7; P_3L, 0·9; P_3W, 0·6; alveolar distance (inclusive) M_{2-4}, 3·2.

Acrobates pygmaeus is common in sclerophyll forests of southeastern Queensland, being known from a specimen as close as Wallangarra, and it is not surprising to find it in the Texas fauna. What is unusual, however, is its relative rarity compared with *Cercartetus nanus.*

PETAURIDAE

Pseudocheirus peregrinus (Boddaert)
(Plate 7L)

All of the specimens representing this Common Ringtail Possum are isolated teeth or tooth fragments, and were recovered from the LPW and 0–20 cm samples from the Bone Chamber. They have been distinguished from teeth of the otherwise very similar *Schoinobates volans* by the lack of an entostylid on the lower molars, and a lack of lingual buttresses on the flanks of the paracone and metacone of the upper molars. In addition, in all the fine details of the complex structure of M_2, the Texas specimens match *Pseudocheirus peregrinus* and not *S. volans.*

Measurements (see Fig. 3) are as follows: F8208, M_3L, 3·9; M_3AW, 2·1; M_3PW, 2·2; F8413, M_4L, 3·8; M_4AW, 2·3; M_4PW, 2·1; F9463, M_4AW, 1·9; F8201; M^3 or ^4L, 3·8; M^3 or ^4AW, 3·4; M^3 or ^4PW, 3·3.

Pseudocheirus peregrinus in southeastern Queensland lives in a wide variety of habitats from open woodland to rainforest, and hence is a poor indicator of palaeoenvironments. It is known from living individuals as close as Wallangarra.

Petaurus Shaw

There are three species of *Petaurus* living in southeastern Queensland: *P. breviceps, P. norfolcensis* and *P. australis*. The first and last are uncommon compared with *P. norfolcensis*. *P. australis* is easily distinguished on the basis of size from the other two species. Separation of the two smaller species is complicated by two factors. First, as Fleay (1947) notes, the two hydridize in captivity and there must remain at least some small doubt about the reality of two species. Second, identification of new or fossil material based on existing Museum samples is complicated by a long history of confusion about the identification of these two species. Tentatively, I have assumed that *P. norfolcensis* may be differentiated from *P. breviceps* by its larger size, proportionately longer rostrum, and wider, fluffier tail base. Only the first character is useful for identifying the Texas fossils. I could find no morphological feature of the cheekteeth that consistently differentiates these two species.

Because of their overall marked similarity, I find it difficult to envisage how they could coexist in the same area. However, the Bone Chamber specimens are neatly divisible into two groups: one resembles *Petaurus breviceps* and the other *P. norfolcensis*.

Petaurus breviceps Waterhouse
(Plate 7M)

Two specimens from the 0–20 cm sample of the Bone Chamber appear to represent this very small species of *Petaurus*. F8413 is not clearly identical to modern *P. breviceps*. Although it closely resembles J11596, an undoubted *P. breviceps* from Eukey, nr. Stanthorpe, it differs in that its molars are slightly wider, the M_2 is slightly longer, and the dentary is deeper. F8205, however, is smaller than J11596.

Measurements are as follows: F8413, posterior edge of alveolus of I_1 to posterior side of posterior root M_5, 10·6; M_{2-5}, 7·7; M_{2-4}, 5·6; M_2L, 2·4; M_2PW, 1·6; M_3L, 2·0; M_3PW, 1·6; M_4L, 1·8; M_4PW, 1·3; depth of dentary body below trigonid M_4, 5·0; F8205, P^2L, 1·0; P^2W, 0·5; P^3L, 1·9; P^3W, 1·2; alveolar length (inclusive) M_{2-4}, 5·0.

Petaurus breviceps living in Queensland inhabits sclerophyll forest, and woodlands of the more interior regions. Compared with the apparent habitat preference of *P. norfolcensis* for the wetter coastal forests, the occurrence of *P. breviceps* rather than *P. norfolcensis* on Viator Hill would not have been surprising. Living individuals of *P. breviceps* have been collected from as close as Stanthorpe.

Petaurus norfolcensis (Kerr)
(Plate 7N)

Four specimens represent this larger glider in the samples removed from the Bone Chamber. F8202-3 very closely resemble J12287, an undoubted *Petaurus norfolcensis* from Kallangur, southeastern Queensland. F8204 is an isolated premaxillary which is similarly indistinguishable from *P. norfolcensis*.

Measurements are as follows: F8202, P_3–M_5, 9·6; M_{2-5}, 8·8; M_{2-4}, 6·8; M_2L, 2·7; M_2PW, 2·0; M_3L, 2·5; M_4L, 2·0; M_4PW, 1·6; M_5L, 1·7; M_5PW, 1·3; F8203, ant. tip I_1 crown to rear of M_5 alveolus, 20·3; alveolar length (inclusive) P_1–M_5, 12·9, alv. length (inclusive) M_{2-5}, 8·9; alv. length (inclusive) M_{2-4}, 6·5; M_3L, 2·3; M_3PW, 1·8; M_4L, 2·1; M_4PW, 1·6; F8204, alv. length (inclusive) I^{1-3}, 4·7; height of unworn I^1 crown, 2·3; F8537, posterior edge I_1 alveolus to posterior edge of M_5 alveolus, 12·5; alveolar length (inclusive) M_{2-4}, 6·9; dentary depth below trigonid M_4, 5·3.

Petaurus norfolcensis normally occupies the wetter coastal sclerophyll forests of Queensland. Its interpreted presence in the Texas Caves suggests either a broader habitat tolerance for this species than could be determined by modern distributions, or else a climatic deterioration in the Texas area since the late Pleistocene.

PHALANGERIDAE

Trichosurus, cf. T. vulpecula (Kerr)
(Plate 7O)

An isolated lower incisor, F8898, appears to represent this Brush-tailed Possum. Unfortunately, the tooth is very worn and identification can only be regarded as tentative. There is no reliable way to eliminate the remote possibility that the tooth could represent *Trichosurus caninus* or even *T. arnhemensis*, and it is largely because of the southwestern Queensland location of Texas (*T. arnhemensis* is only known from northern Australia), and the observation that no other species in the Russenden (rear) fauna is known to require a rainforest habitat (*T. caninus* does, at least in Queensland), that the tooth is assumed to represent *T. vulpecula*.

The very wide habitat tolerance (except rainforest) of *Trichosurus vulpecula* makes it useless as a tool for interpreting the palaeoenvironment. It is curious that this normally very abundant possum is very rare in the Russenden (rear) faunas. It is absent in the Cement Mills fauna (Bartholomai 1977). The rarity to absence of this possum in these late Pleistocene faunas may have a common cause. Live animals have been observed around Viator Hill (Archer 1978c).

?POTOROIDAE

Genus indet.
(Plate 7R)

F8362 (Fig. 5 for measurements) from the Bone Chamber, is not clearly referable to any known marsupial taxon. It appears to represent a left M^1 from which the protocone has been lost. The posterior half of the tooth has a well-developed transverse loph, but there was evidently no anterior loph. The interpreted buccally situated
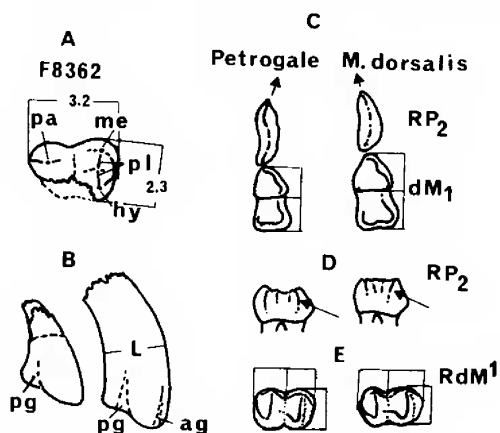

FIG. 5: A, F8362, gen. indet., but possibly a potoroid LM^1. Anterolingual (lower left) dashed line indicates position of missing protocone. Abbreviations: *hy,* hypocone; *me,* metacone; *pa,* paracone; *pl,* posterior transverse loph. B, RI^1(F8495) and RI^2(F9464) of *Protemnodon brehus.* The position of maximum buccal transverse length is indicated by L. Abbreviations as follows: *ag,* anterior groove; *pg,* posterior groove. C–D, characters in addition to size used to separate anterior juvenile cheekteeth of *Petrogale* sp. and *Macropus dorsalis.* C, indicating that in P_2, the anterior end of the occlusal crest is generally directed relatively more lingually in *M. dorsalis;* the trigonid of M_1 in *M. dorsalis* is relatively longer. D, the anterolingual "vertical" crest (indicated by arrow) of P_2 in *M. dorsalis* normally is relatively less vertical than it is in *Petrogale* sp. Figures are not to the same scale.

paracone has short longitudinal crests extending anteriorly and posteriorly from its apex, but there is no remnant of a transverse crest extending lingually towards the now missing protocone. There is a posterior cingular basin. The tooth is unlike the otherwise similar M_2 of petaurids in having the high and complete posterior transverse loph. For this reason it is concluded here to represent a potoroid tooth, but of uncertain generic affinities. It is possible that it could be an abnormal M^1 of *Aepyprymnus.*

POTOROIDAE

Aepyprymnus rufescens (Gray)
(Plate 7Q)

One tooth, F8479, represents this taxon in the Joint fauna, but eleven specimens were recovered from the Bone Chamber. It was identified on the basis of details of molar morphology, and the posteriorly increasing molar gradient from M_2 to M_4, a feature confined to *Aepyprymnus* among potoroid genera.

Measurements on Bone Chamber specimens are as follows: F8331, P^3L, 9.2; P^3PW, 3.4; F8332, M_5L, 6.6; AW 4.8; F8407, M_{2-4}, 18.1; M_2L, 5.2; M_3L, 6.3; M_4L, 7.0; F8243, M^5L, 6.8; F8241, M^5L, 7.3; F8242, P_2L, 6.5; M_1L, 4.9; M_1PW, 3.6. These measurements are comparable to those of modern specimens and specimens from the Cement Mills fauna of southeastern Queensland (Bartholomai 1977).

Aepyprymnus rufescens normally inhabits savannah woodlands and sclerophyll forests, habitats still present on Viator Hill. The nearest living population known is at Stanthorpe.

MACROPODIDAE

STHENURINAE

Procoptodon texasensis n. sp.
(Plate 8A, C, E Fig. 6)

HOLOTYPE: Queensland Museum F7894, RM^1 (damaged) and excavated entire RP^3; collected H. Godthelp, P. Rainbird, and M. Archer, 25 February 1975, as part of a breccia lump. From breccia (at the breccia keyhole) in The Joint (VR-5), Texas Caves (Long. 151°27′E, Lat. 28°56′S), Viator Hill, along Pike Creek, southeastern Queensland.

DIAGNOSIS: Differs from *Procoptodon pusio* in having a P^3 that is markedly larger; has a well-developed posterobuccal crest that is almost half the length of the crown; a completely cuspose

buccal longitudinal crest; a lingually convex occlusal edge on the lingual longitudinal crest; a more complexly crenulated longitudinal basin; and a lingual crest that continues to the anterior edge of the tooth.

Differs from *P. goliah* in having a P^3 with a much better-developed posterobuccal crest; a completely cuspose buccal longitudinal crest; a lingually convex occlusal edge on the lingual longitudinal crest; a wider longitudinal basin between the lingual and buccal crests; less well-developed transverse crenulations in the longitudinal basin between the well-developed main anterior and posterior transverse crests; a much more brachyodont crown; and a more oval than subquadrate occlusal crown outline.

Differs from *P. rapha* to which it is otherwise most similar, in having a shorter-crowned P^3 (antero-posterior length) which has a smoothly convex lingual crest; a buccal crest composed of four discrete cusps ununited into a crest for almost half of their height above the base of the longitudinal basin; much less well-developed crenulations in the longitudinal basin between the similarly less well-developed but distinct anterior and posterior transverse crests; much more brachyodont crown; less well-developed crenulations connecting the large posterobuccal crest to the main longitudinal buccal crest; and a more oval, less triangular outline.

DESCRIPTION: The M^1 is thoroughly broken, but was *in situ* in a small fragment of bone, immediately below the unerupted P^3. Its roots had

FIG. 6: Terminology, and measurements (mm) of the Rp^3 of F7894, the holotype of *Procoptodon texasensis* n. sp. A, occlusal view; B, lingual view; C, buccal view; D, posterior view, and E, anterior view. Abbreviations as follows: *aclc*, anterior cusp of the lingual crest; *acb*, anterior cingular basin; *bc*, buccal crest; *bc1–4*, cusps 1 to 4 on buccal crest; *lc*, lingual crest; *mv*, median longitudinal valley; *pbc*, posterobuccal crest; *pcb*, posterior cingular basin; and *pclc*, posterior cusp of the lingual crests.

begun to resorb, and the top of the crypt for P^3 was well down, at the level of the M^1 crown-root junction, suggesting the P^3 was close to erupting at the time of death. Although no roots were preserved on P^3, the base of the crown was flush with the surface of the breccia fragment, and any roots would have been removed by erosion or abrasion. I excavated the P^3 from the bone fragment, leaving part of the root of the crypt intact above the base of the M^1 crown.

The M^1 fragment includes the base and posterior face of the metaloph, and the outline of the remainder of the crown, which is broken off below the enamel. The metaloph has a smooth posterior surface and no remnant of a posterior cingulum or pocket. The occlusal edge of the metaloph fragment is abruptly recurved posteriorly and strongly suggests that it is close to the actual occlusal margin of the crown. If this is the case, the tooth was very low-crowned compared with *Procoptodon rapha* (see Plate B). The basal crown outline suggests the buccal length of the tooth was longer than the lingual length. The lingual vertical face of the hypocone reclines buccally.

The P^3 crown outline is essentially oval, but wider posteriorly than anteriorly because of the large posterobuccal crest. The crown height is low compared with *Procoptodon rapha*. There are three longitudinal crests; a long lingual and buccal crest and a shorter posterobuccal crest. The lingual crest also forms the curving, convex lingual edge of the occlusal edge of the crown and extends from the extreme anterior to posterior edges of the tooth. Its occlusal edge is complete. Along its length, two poorly-defined cusps can be recognized: a minor anterolingual cusp defined only by the positions of a small transverse ridge that extends buccally towards the buccal crest; and a somewhat larger posterolingual cusp similarly defined by the position of a posterior transverse ridge that extends buccally to the base of the buccal crest. The buccal crest actually consists of four blade-like cusps arranged in a row and joined near the base of the crown's occlusal surface. This crest terminates anteriorly with a large anterobuccal cusp that has a small vertical crest extending to the anterior edge of the crown, and posteriorly with a long blade-like cusp whose occlusal edge ascends posterodorsally to the posterior edge of the crown. At both the anterior and posterior ends of the crown, the lingual and buccal crests converge medially and unite near the base of the crown. The four cusps forming the buccal crest are complexly oriented. The large anterobuccal cusp has a semi-circular occlusal edge whose
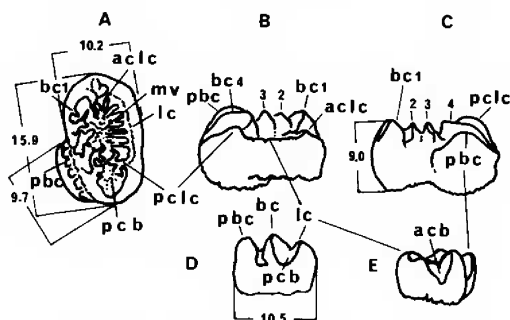
anterior end swings lingually to contact a smaller ridge extending buccally from the main lingual longitudinal crest. The two enclose the anterior end of the median longitudinal basin of the crown. The posterior end of the occlusal edge of the anterobuccal cusp of the buccal crest bifurcates and the main limb ascends the anterobuccal wall of the tooth forming a prominent near-vertical buccal ridge. The lesser limb swings posteriorly and contacts the base of the second cusp of the buccal crest. This has a smaller and linear occlusal edge oriented anterolingually. Its anterior end abuts against the flank of the anterior cusp, and its posterior end merges into the base of the buccal crest. The third cusp is oriented transversely, the lingual edge ascending towards the longitudinal median basin, and the buccal edge ascending to contact the valley between the buccal and posterobuccal crests. The fourth and largest cusp is oriented longitudinally, its posterior edge being the posterior edge of the buccal crest, and its anterior edge turning sharply lingually just before contacting the third cusp. At this point it bifurcates and the two resulting ridgelets ascend towards the base of the longitudinal median basin. The posterior of these two ridgelets then swings posterolingually and contacts a prominent buccal ridge from the posterior cusp on the lingual longitudinal crest. They thus form the posterior end of the median longitudinal basin of the crown. The two transverse links between the lingual and buccal longitudinal crests, besides enclosing the median longitudinal basin, define a steep wedge-shaped anterior basin whose apex is the anterior edge of the tooth, and a broader posterior basin or pocket. The posterobuccal crest, like the lingual crest, has an entire occlusal edge. Its anterior end originates about midway along the buccal margin of the crown, and about half way down its side. From this point it descends to a height just below that of the posterior cusp of the buccal crest, and then ascends again posterolingually, to contact the buccal crest half way up the buccal face of the posterior cusp of the buccal crest. There are no enlarged transverse ridges linking the occlusal edge of the posterobuccal crest to the flank of the buccal crest. All three major crests have numerous associated low-relief flanking ridgelets, although the cusps of the buccal crest have less than the median flanks of the other two. All three major longitudinal crests are about subequal in height, and compared to *P. rapha,* very low.

DISCUSSION: It is first necessary to consider why F7894 has in fact been referred here to *Procoptodon* rather than *Sthenurus.* Stirton and Marcus (1966) and Tedford (1966) regard that the P^3 of species of *Procoptodon* is more bulbous at its base, with a broader more massive crown. The only possible overlap with other genera noted by Stirton and Marcus (1966) is *Sthenurus occidentalis.* Bartholomai (1970), in reviewing Queensland *Procoptodon* specimens then known, concludes that the concept of the genus as defined by Stirton and Marcus (1966) is applicable to Queensland specimens. I have compared F7894 with all species of *Sthenurus* and *Procoptodon* for which upper premolars are known, including some species of *Sthenurus* such as *S. orientalis* for which upper premolars were previously unknown. Comparison has also been made with the excellent review by Marcus (1966) of the extensive Bingara *Procoptodon* samples, as well as with the Bingara specimens in the collections of the Australian Museum. F7894 has the bulbous P^3 crown that is interpreted to be characteristic of *Procoptodon.* But as Stirton and Marcus (1966) point out, this feature is also present in some specimens of *Sthenurus occidentalis* (e.g., Western Australian Museum no. 63.2.143). The P^3 of *S. occidentalis* differs from this tooth in species of *Procoptodon* and specifically F7894, as follows: it has an anteriorly more narrowed crown; a lack of well-formed transverse anterior and posterior links between the lingual and buccal crests; a less well-developed posterobuccal crest than *P. rapha* (and F7894); and a more complete, less dentate occlusal edge on the buccal crest. Tedford (1966) figures a P^3 of *Sthenurus atlas* which has a large posterobuccal crest otherwise characteristic of *P. rapha* (and F7894). However, it also differs from that tooth in species of *Procoptodon* in the same ways as does *S. occidentalis* except for the larger size of its posterobuccal cusp.

Compared with the P^3 of species of *Procoptodon,* F7894 is unlike *P. rapha* in enough features to preclude need for additional comment. It resembles the P^3 of *P. goliah* in absolute crown length, but clearly differs from this species in the development of the posterobuccal crest, as well as by other features noted in the diagnosis. Samples of *P. rapha* P^3s described by Marcus (1976) are outside the size range of F7894 and similarly differ in other features noted in the diagnosis. The massive development of the posterobuccal crest in F7894 is approached in *P. rapha* and for this reason, it has been concluded here that *P. texasensis* is most closely related to *P. rapha.*

Bartholomai (1977) notes a dentary of *Procoptodon,* F4548, from the Pleistocene Cement Mills fauna of southeastern Queensland, that he

regards to be similar to *P. rapha*. It differs from specimens of *P. rapha* in having less ornamentation on the only two intact teeth, M_4 and M_5. He concludes that it may represent extreme intraspecific variation, but without structurally intermediate specimens, it cannot be assigned to *P. rapha* with certainty. The similarities of this *Procoptodon* specimen to *P. rapha,* the general similarities of the Cement Mills fauna (see below and Table 10) to the Texas Caves faunas, and the close geographic position of the two areas, suggest the possibility that the Cement Mills *Procoptodon* specimen may be conspecific with *P. texasensis.* The less well-developed crenulations of the Cement Mills specimen are features one would expect for molars of *P. texasensis.* As noted above, the crenulation of P^3 of *P. texasensis* is certainly less well-developed than P^3s of *P. rapha.*

ORIGIN OF SPECIFIC NAME: The specific name is given in dual reference to the Texas Caves, of which The Joint (the type locality) is one, and the Texas Beds to which the limestone belongs. The Texas Beds is evidently the same formation in which the cave deposits at Gore were formed (Siemon 1973), and from which were obtained specimens including F4548, the only other specimen possibly referable to *Procoptodon texasensis,* which form the basis of the Cement Mills fauna (Bartholomai 1977).

Sthenurus Owen

All of the remains of *Sthenurus* from the Texas caves are fragmentary and too incomplete to allow confident identification. Nevertheless, there are a few specimens which can be tentatively referred to known species. Material representing all known species of *Sthenurus* was examined during this study, although several species are poorly-known.

Sthenurus sp., cf. S. atlas (Owen)
(Plate 7U)

Two specimens from The Joint, F8380 and F7895, with simple unornamented enamel, are very similar to specimens of *Sthenurus atlas.* F7895, a left P_3, is worn in a manner suggesting it might even be part of F8380, a left dentary fragment with M_{2-4}. These specimens have the characters of *S. atlas* as outlined by Tedford (1966). F8380 is also similar to *S. andersoni* but smaller. The P_3, F7895, is longer than the molars, which is a character of *S. atlas* and not *S. andersoni.*

Measurements are as follows: F7895, P_3L, 16·1; P_3AW, 6·5; P_3PW, 8·1; F8380, $M_{2-4}L$, 38·4; M_2L, 10·2; M_2AW, 9·0; M_2PW, 9·7; M_3L, 12·9; M_3AW, 10·0; M_3PW, 10·4; M_4L, 14·7; M_4AW, 11·4; M_4PW, 11·7.

Sthenurus atlas has been recorded from three other Pleistocene sites in eastern Australia: Lake Menindee, Wellington Caves (Tedford 1966), and Lake Victoria (Marshall 1973). This Texas specimen represents its first possible occurence in Queensland.

Sthenurus sp., cf. S. oreas De Vis
(Plate 7T)

At least two isolated lower molars from The Joint and one from the Bone Chamber, are very similar to this species. There are no diagnostic characters that would enable positive reference of isolated lower molars to this species, but they are similarly ornamented and comparable in size to the materials referred to this species by Bartholomai (1966). They also show similarities to the Pliocene *S. antiquus.*

F8239, an isolated upper molar, is also similar to *Sthenurus oreas,* but this similarity depends on the doubtful interpretation of the tooth as an M^1. If in fact it is an M^2, in size and morphology it would more closely resemble F2926, an unallocated specimen from the Chinchilla Sand (Bartholomai 1966), or *S. occidentalis* from which it differs only in that the premetacrista is fractionally better-developed in the Texas specimen.

Measurements are as follows: F7900 (Joint), $M_{3?}AW$, 11·4; $M_{3?}PW$, 11·5; F8307 (Bone Chamber), ML, 12·2; F8239, $?M^1L$, 11·7; $?M^1AW$, 10·8; $?M^1PW$, 10·8;

Sthenurus oreas has been recorded from the Cement Mills, Wellington Caves, Bingara, and eastern Darling Downs Pleistocene faunas (Bartholomai 1966, Tedford 1966, and Marcus 1976).

Sthenurus sp., aff. S. occidentalis Glauert
(Plate 7S)

F8529 from The Joint, is a right maxillary fragment with M^1, and damaged P^2 in place. Regretably few species of *Sthenurus* are known from P^2, thus making comparison difficult. P^2 of this specimen has a pronounced posterobuccal cingular pocket, a structure so far known to occur only in *S. occidentalis.* The M^1 of F8529 is also similar in morphology to that tooth in *S. occidentalis,* with comparably developed longi-

tudinal cusp crests. However both teeth are smaller than the corresponding teeth in *S. occidentalis* (e.g. see Merrilees 1968). In size they are closer to *S. brownei* but P^2 in this species appears to lack the posterobuccal pocket.

Measurements are as follows: F8529, P^2–M^1, 20·3; P^2L, 8·9; M^1L, 11·0; M^1AW, 9·9.

Sthenurus occidentalis has been recorded from Mammoth Cave in Western Australia, Brothers Island in South Australia, King Island and Scotchtown Cave, Tasmania.

MACROPODINAE
Protemnodon roechus Owen
(Plate 8A, B)

A partial skull (F6132) from the side of the entrance rubble cone of Russenden (rear) Cave is the only Texas caves specimen that undoubtedly represents this very large extinct kangaroo. It has the depressed anterolingual cingular pockets and markedly curved longitundinal crest of P^3 which are characteristic of *Protemnodon roechus* (Bartholomai 1973). This particular individual has a bone swelling along the buccal alveolar rim of the maxillary between P^3 and M^3, suggesting disease.

Measurements as follows: P^3–M^5, 80·9; $M^{2–5}$, 63·4; $M^{2–4}$, 45·8; P^3L, 19·6; P^3AW, 10·3; P^3PW, 10·6; M^2L, 12·5; M^2AW, 12·6; M^2PW, 12·7; M^3L, 16·1; M^3AW, 13·9; M^3PW, 16·6; M^4L, 17·3; M^4AW, 14·8; M^4PW, 14·3; M^5L, 17·8; M^5AW, 14·1; M^5PW, 13·2.

Protemnodon roechus has been recorded from the eastern Darling Downs, Gore, Bingara, Wellington Caves (Bartholomai 1973, 1977).

Protemnodon brehus (Owen)
(Plate 8H, J)

Some specimens of *Protemnodon* from the Joint, and possibly one from the Bone Chamber of Russenden (rear) Cave, represent this species. The Joint specimens are all fragmentary but include an isolated P^3 (F8238) and M_2(F7916) which demonstrate features regarded by Bartholomai (1973) to be indicative of *P. brehus*, rather than the other large species, *P. roechus*.

Two isolated large upper incisors, evidently I^1 and I^2 clearly do not represent *P. anak* or *P. roechus*, based on specimens illustrated by Bartholomai (1973), and F(AM)38785 which preserves the upper incisors and the anterior end of a P^3 identifiable as *P. roechus*. For this reason they are interpreted here to represent *P. brehus*. The I^1 is almost unworn and hence probably not the same individual as the I^2. The I^2 (F9464)

differs from that of *P. roechus* (present in F(AM)38785) and *P. anak* (e.g. F3672) in having a pronounced posterior groove on the buccal surface of the crown, and differs from *P. roechus* in having the crown proportionately shorter (anteroposteriorly) near the base. The only known I^1s of *P. roechus* (F5053, F(AM)38785) are both very worn thereby obliterating details of distal crown morphology. F8495 is however markedly shorter (anteroposteriorly)-crowned (see Fig. 5) having a maximum buccal transverse (anteroposteriorly) length of 11·4 as opposed to 16·3 (F5053) and 15·7 (F(AM)38785) for *P. roechus*. This I^1 length in *P. anak* (F651, F3672) is shorter, being 9·1 in F651, and 10·3 in F3672. The distal end of the crown has a broad buccal posterior vertical groove and a smaller anterior groove. There are no traces of these grooves in the *P. roechus* specimens. There were probably similar grooves in at least some *P. anak* (e.g. F3672).

F7916 is a large right lower molar (length, 17·0; AW, 11·1; PW, 11·4) interpreted here to represent *Protemnodon brehus* because it lacks an anterolingual notch in the anterior cingulum and has a posterior cingulum, features which are normally present in *P. roechus* (Bartholomai 1973).

F8154 (Plate H1), an isolated premolar fragment from the Bone Chamber, may represent this species. It resembles the P^3 of F4947 but differs in evidently having been broken from a considerably taller crown; in that the anterior crest from the anterior cusp is shorter than that structure in F4947; and in that the buccal face of the crown fragment is planar rather than curved. The tooth was unerupted.

Protemnodon brehus has been reported from many eastern Australian Pleistocene faunas including the Cement Mills, eastern Darling Downs, Wellington Caves, Bingara, Lake Victoria, Lake Menindee, and Lake Tandau faunas, and from several isolated localities such as Coreena and Planet Downs, in central and northwestern Queensland respectively, the Warburton River, South Australia, and Mammoth Cave, Western Australia (Bartholomai 1973, 1977, Marcus 1976, Tedford 1967, Merrilees 1973, and Marshall 1973).

Thylogale sp.
(Plate 7V, W)

Two upper third incisors from The Joint, F7923 and F7947, are notched all along their occlusal length, a feature present in the I^3 of *Thylogale stigmatica* and *T. thetis*. In the same sample are

a fragmentary dentary, F8524, and an isolated upper first molar, F7095. The last two specimens represent a very small macropodid with a dental morphology similar to that of *Thylogale* species.

Small isolated macropodid teeth from the Bone Chamber may also represent a species of *Thylogale*, but none of the specimens from this deposit have confidently been referred to a species of this genus. They include F8172, F8173 and F8186, isolated upper molars which are similar in morphology to those of Queensland species of *Thylogale*.

Measurements are as follows: (Joint) F8524, $P_3 - M_3$, 18·3; M_2PW, 3·4; P_3L, 4·2; F7093, M^1PW, 4·7; (Bone Chamber, Russenden (rear) Cave), F8172, M^xL, 5·0; M^xAW, 3·6; M^xPW, 3·6; F8173, M^1L, 5·3; $?M^1AW$, 4·0; $?M^1PW$, 4·2.

The I^3 morphology suggests *Thylogale billardieri* is not represented, and it is therefore probable that The Joint specimens represent either *T. stigmatica* or *T. thetis*, which in terms of dental morphology alone, are very similar species. Thylogales living today in southeastern Queensland seem to prefer rainforests or adjacent wet sclerophyll forests. The presence in the Texas cave deposits of Thylogales is thus surprising. Nothing else in the deposits requires interpretation of such a well-watered palaeoenvironment. It can only be concluded that they were either occupying habitat uncharacteristic of the modern species in southeastern Queensland, or that there was in fact a residual pocket of wet sclerophyll forest or rainforest in the vicinity of Viator Hill. Live animals are known from as close as Killarney.

Petrogale sp.
(Plate 7Y)

Specimens referable to Rock-wallabies were common in The Joint but less common in the Russenden (rear) Cave deposits, as well as on the surface of other Texas Caves such as Bevans Pot. They have been identified on the basis of size, premolar and molar morphology. The only taxa with which they could have been confused are species of *Thylogale* (which are smaller, have shorter premolars, and markedly different upper molar morphology), and *Macropus (Prionotemnus) dorsalis* (which differs in being larger, and in details of the M^1 and P^2 morphology (Fig. 5).

TABLE 5: MEASUREMENTS OF *PETROGALE* SP., FROM BEVANS POT, THE JOINT, RUSSENDEN (REAR) CAVE (BONE CHAMBER SEDIMENTS), AND MODERN SOUTH-EASTERN QUEENSLAND

Parameter		P^2–M^3	P^3–M^4	M^2PW	P^2L	P^3L	P_2–M_3	P_3–M_4	M_2PW	P_2L	P_3L
The Joint	x̄	25·1	—	6·15	5·77	7·20	19·50	—	3·80	4·86	6·47
	N.	1	—	2	7	2	2	—	3	7	3
	O.R.	25·1	—	6·1–6·2	5·5–6·0	7·0–7·4	18·3–20·7	—	3·4–4·4	4·3–5·5	6·2–6·7
	S	—	—	0·07	0·19	0·28	1·70	—	0·53	0·36	0·25
	C.V.	—	—	1·15	3·27	3·93	8·70	—	13·93	7·41	3·89
Russenden	x̄	—	—	—	—	—	—	—	4·13	—	—
	N.								3		
	O.R.	—	—	—	—	—	—	—	4·0–4·3	—	—
	S	—	—	—	—	—	—	—	0·15	—	—
	C.V.	—	—	—	—	—	—	—	3·70	—	—
Bevans Pot	x̄	22·93	25·43	5·34	5·65	6·93	21·53	23·21	4·25	5·02	6·07
	N.	8	4	14	8	4	3	7	11	5	6
	O.R.	21·5–24·3	24·1–26·7	5·1–5·5	5·4–6·0	6·9–7·0	20·7–22·2	21·8–24·7	4·0–4·6	5·0–5·1	5·9–6·3
	S	1·05	1·12	0·13	0·21	0·05	0·76	0·85	0·21	0·04	0·16
	C.V.	4·57	4·42	2·50	3·66	0·72	3·55	3·67	4·97	0·89	2·69
Modern SE.Q.	x̄	—	25·16	5·21	—	7·10	—	22·54	4·16	—	6·14
	N.	—	9	10	—	9	—	8	8	—	8
	O.R.	—	23·8–26·9	4·9–5·5	—	7·0–7·3	—	19·4–24·5	3·9–4·4	—	5·9–6·5
	S	—	1·01	0·19	—	0·10	—	1·75	0·17	—	0·18
	C.V.	—	4·01	3·56	—	1·41	—	7·78	4·06	—	3·01

The taxonomy of Petrogales is currently undergoing revision (G.B. Sharman, pers. comm.) and no attempt has been made here to identify the species present in the Texas Caves. In general, they cannot be differentiated, on the basis of morphological dental features, from specimens in the Queensland Museum, from areas near Texas (e.g. Stanthorpe, Warwick) previously regarded as *Petrogale penicillata*.

Measurements are given in Table 5.

Among the specimens from The Joint were some illustrating dental anomolies or features not noticed among modern specimens. F8405, A left P^2, may be abnormal in completely lacking any posterior cingular pocket, and having instead an isolated cingular shelf. F8882, a left upper molar, has a small cusp on the posterior flank of the paracone, a feature also present in some specimens from Bevans Pot.

Modern species of *Petrogale* inhabit rocky areas in almost all habitats throughout Australia. Their presence on Viator Hill is therefore not surprising. The abundance of unmineralized and intact skulls on the surfaces of many of the Texas Caves suggests these animals were living on Viator Hill within historic times. However, no sightings were made by us during several trips to the Texas Caves area.

?Petrogale sp.
(Plate 7X)

F8417, a right dentary from the Bone Chamber with M_{2-4}, M_5 in the crypt, and alveoli for $I_1 - P_3$, is not clearly referable to *Petrogale*. The alveoli for P_3 indicate that it was a very large tooth, larger than that tooth in any *Petrogale* examined during this study. The molars are also relatively longer. The large size of these teeth however is still smaller than those of specimens referred below to *Macropus (Prionotemnus)*, aff. *M. (P.) agilis siva*.

Measurements are as follows: $P_3 - M_4$, 25·8; P_3 (alveolar length), 6·3; M_1PW, 4·5.

Macropus (Prionotemnus) dorsalis (Gray)
(Plate 7Z)

Numerous specimens from The Joint and one from the Bone Chamber of Russenden (rear) Cave appear to represent this medium-sized Black-striped Wallaby. It has been differentiated from *Petrogale* spp. and *Macropus* cf. *M. (Prionotemnus) agilis siva* by the following features: absolute size larger than *Petrogale* but smaller than *Macropus* cf. *M. (Prionotemnus) agilis siva*; long blade-like premolars similar to those of *Petrogale* but differing as shown in Fig. 5; trigonid of M_1 relatively longer anteroposteriorly, with a wider anterior cingulum than specimens of *Petrogale*; M^1 slightly longer than that tooth in *Petrogale*; and a relatively narrower anterior cingulum and a lower forelink on molars posterior to M^1.

Measurements are given in Table 6, and clearly indicate the close similarity between The Joint and modern specimens.

Macropus (Prionotemnus) dorsalis has also been reported from the Pleistocene Cement Mills fauna by Bartholomai (1977). The nearest record of live *M. dorsalis* to Texas is probably Mt. Lindsay, southeastern Queensland. Individuals have been found in savannah woodlands, as well as rainforest and brigalow. The presence of this species in the Texas caves is therefore not unexpected.

TABLE 6: MEASUREMENTS OF FOSSIL *Macropus dorsalis* FROM THE JOINT, AND MODERN SOUTHEASTERN QUEENSLAND SPECIMENS.

Parameter		$P^2–M^3$	M^2W	P^2L	$P_2–M_3$	M_2PW	P_2L
The Joint	$\bar{x}$	—	6·15	5·68	—	—	4·83
	N.	0	2	5			4
	O.R.	—	6·1– 6·2	5·5– 5·8	—	—	4·7– 5·0
	S	—	0·07	0·13	—	—	0·13
	C.V.	—	1·15	2·30	—	—	2·61
Modern SE.Q.	$\bar{x}$	25·60	5·73	5·70	22·97	4·52	5·12
	N.	6	6	6	6	6	6
	O.R.	24·9– 26·7	5·1– 6·4	5·4– 6·0	21·5– 24·3	4·2– 4·8	4·9– 5·6
	S	0·66	0·52	0·24	1·07	0·22	0·26
	C.V.	2·59	9·01	4·15	4·64	4·93	5·16

Macropus (Prionotemnus) sp., aff. M. (P.) agilis siva (De Vis)
(Plate 7CC, DD)

There are numerous isolated teeth from the Bone Chamber of Russenden (rear) Cave, and one maxillary fragment (F9444) from the Joint breccia, which are clearly referable to the subgenus *Prionotemnus* in the sense of Bartholomai (1975). They have high-crowned macropodine type molars, well-developed parastylar crests on the upper molars, no forelinks, and long trenchant premolars. F9444, is a right maxillary fragment with P^2, M^1 and M^2. P^3 has been excavated from the crypt below P^2 and M^1. It most closely resembles specimens of *Macropus (Prionotemnus) agilis siva,* but differs in that in the M^2 of F9444, the preparacrista and forelink are better-developed, and the M^1 and M^2 are anteriorly narrowed. Compared with modern specimens of *M. (P.) a. jardinei,* F9444 is larger overall; has a better-developed preparacrista on M^2; M^1 and M^2 are narrowed anteriorly, although one of the modern specimens examined, J14605, has slightly narrowed anterior ends; P^3 of F9444 has a less well-developed anterolingual cingulum such that the crown is roughly triangular in outline as in species of *Troposodon,* although again one modern specimen observed, J14565, resembles F9444 in this feature; the base of the M^2 and M^1 hypocones in F9444 are swollen and extend anterolingually such that the lingual medial intersection with the base of the protocone forms a straight-sided V-shape, rather than the U-shape of modern specimens; and the forelinks in F9444, although poorly-developed, are still generally better-developed than those structures in modern specimens.

Some specimens from the Bone Chamber in Russenden (rear) Cave are probably also referable to *Macropus (Prionotemnus) sp., cf. M. (P.) agilis siva.* For example, F3231, an LM^1, and F8181, an LP_2, are almost certainly referable to this taxon. Other isolated teeth from the Bone Chamber, although referable to the subgenus *Prionotemnus* are less clearly referable to the same taxon as F9444. These include F8293, an RM^1 that has a very large parastylar crest and even a post-paracone crest that is so well-developed it resembles a stylar cusp. A slight depression separates this post-paracone crest from the paracone. Possibly it is an abnormal tooth. F8293, an RM^1, also has a very prominent parastylar crest, post-paracone crest, and even a very slight forelink. F8195, an RM_1 has an enclosed anterior trigonid basin, an uncommon structure present in some *siva* specimens (e.g. F3598), but also some *M. dryas* specimens. F8187, a lower right molar, also has an enclosed anterior trigonid basin, but one which is closed by the presence of two discrete anterior cingular cusps.

Measurements are as follows: F9444, P^2L, 8·4; P^3PW, 5·0; M^1L, 8·3; M^1AW, 5·6; M^1PW, 6·1; M^2L, 9·5; M^2AW, 7·2; M^2PW, 7·8; P^3L, 10·2; P^3PW, 5·0; F8181, P_2L, 7·2; P_2PW, 3·6; F8231, M^1L, 8·7; M^1PW, 4·7; F8195, M_1L, 8·1; M_1AW, 4·7; M_1PW, 5·3; F8187, M_xL; 9·6; M_xAW, 5·1; M_xPW, 6·3; F8293, M^1L, 8·6, M^1AW, 6·1; M^1PW, 6·4.

Macropus (Prionotemnus) agilis siva has been recorded from the Queensland Pleistocene Cement Mills and eastern Darling Downs faunas, as well as from Monto, central Queensland (Bartholomai 1975). Modern *M. agilis* is restricted to northern Australia and New Guinea, but at least one population of *M. a. jardinei* still survives on Stradbroke Island in southeastern Queensland. Modern animals appear to favour savannah woodlands or open forest areas, habitats abundantly present today on and around Viator Hill.

Macropus (Prionotemnus) sp., cf. M. (P.) thor (De Vis)
(Plate 7AA)

Two specimens from The Joint, F8473 and F8859, may represent this uncommon Pleistocene species. The lower molars have only a slight vertical posterior hypolophid groove. P_3 is relatively small and unlike the large P_3 of some of the other species of this subgenus such as *Marcopus (Prionotemnus) agilis.* Reference of these fragmentary Joint specimens to this taxon is very tenuous, and it is only suggested here in preference to leaving them unreferred to any known species, because they reveal an overall resemblance to the eastern Darling Downs specimens referred by Bartholomai (1975) to *M. thor.*

Measurements are as follows: F8859, M_5L, 13·1; M_5AW, 8·3; M_5PW, 8·3; F8473, P_3L (worn), 7·1; P_3AW, 3·2; P_3PW, 3·4; M_3L, 11·5; M_3AW, 7·7; M_3PW, 8·2; M_4L, 13·4; M_3AW, 9·2; M_3PW, 8·4.

Macropus (Prionotemnus) thor has only been recorded from the Pleistocene deposits of the eastern Darling Downs (Bartholomai 1975).

Macropus (Osphranter) sp., cf. **M. (O.) altus**
(Owen)
(Plate 8K)

Several specimens from both The Joint and Russenden (rear) Cave are morphologically similar to specimens of modern *Macropus (Osphranter) robustus* as well as to fossil *M. (O.) altus*. They are very large, lack forelinks and have poorly-developed parastylar crests on the upper molars, poorly-developed posterior vertical grooves on the lower molars, and wide well-developed premolars. One isolated I^3 has a single vertical groove near its anterior end.

Figure 7 is a comparison of the means of cheektooth dimensions for P^2 to M^4 of various *Macropus (Osphranter)* samples based on Table 7: a modern sample from southeastern Queensland (mainly localities near Warwick); a modern sample from mid- and northeastern Queensland (not including any *M. (O.) antilopinus)*; Texas Caves specimens; eastern Darling Downs *M. (O.) altus* (after Bartholomai 1975); and the single known upper cheektooth row of *M. (O.) stirtoni* (after Marcus 1976). It is clear that the two modern *robustus* samples differ from each other to a greater extent than the eastern Darling Downs *altus* sample differs from the single known upper tooth row of *stirtoni*. It is also apparent that the northeastern sample of *robustus* is more similar in size to the *altus* sample than is the southeastern *robustus* sample. This is particularly evident in the dimensions of P^3 and M^4 which are about intermediate between those of the southeastern *robustus* and *altus* specimens. The *altus* sample is clearly different from both *robustus* samples in the dimensions of P^2 and M^1. The Texas specimens do not clearly ally with either the modern *robustus* or *altus* samples. In the size of P^3, (inferred from a section of the tooth visible in F7896), and M^1, the Texas specimens closely approach the *altus* sample. However, the M^2 is intermediate between northeastern *robustus* and the *altus-stirtoni* specimens, and the M^3 broadly overlaps with that tooth in northeastern *robustus* and is clearly smaller than the *altus-stirtoni* specimens M^{4-5} have not been clearly identified among the isolated Texas molars.

On the basis of the known *Macropus (Osphranter)* populations, it could only be concluded that the Texas specimens, albeit few in number, suggest an animal intermediate between modern northeastern Queensland *robustus* and *altus-stirtoni* in size, and therefore, not clearly referable to one or the other. I have tentatively referred it here to *altus* on the basis of the premolar and M^1 size. No clear morphological characters have been noted other than size which enable separation of *robustus-antilopinus* from *altus* samples (Bartholomai 1975).

This points out the very unsatisfactory state of *Osphranter* taxonomy. Owen (1874) describes *cooperi* on the basis of a very poorly-preserved dentary. Bartholomai (1975) describes the holotype's distortions, and concludes that *cooperi* is a synonym of *altus* Owen, 1874, the latter name being preferred as the senior synonym. Marshall (1973) concludes (but without a detailed analysis) the same synonmy, and in addition suggests *birdselli* Tedford, 1967 is yet another synonym of this species (he regards the senior synonym to be *cooperi*). Marcus (1976) describes *Osphranter stirtoni* having made comparisons with the cast of the holotype of *cooperi* as well as specimens of modern *Macropus giganteus* and 'Pan-Australian' samples of modern *robustus*. He evidently did not have Bartholomai's (1975) revision of the group containing the amplified description of *altus*. As a result, Marcus's (1976) diagnosis does not serve to distinguish *stirtoni* from *altus*, although the two may be distinct. In fact, none of the diagnoses in any of the works cited enable the species established or revised to be satisfactorily diagnosed from all of the other species. Bartholomai (1975) admits the sample of *altus* is too small to compare statistically with all of those of modern *robustus* and *antilopinus*, and measurements given indicate that these would probably overlap in some absolute dimensions. The diagnosis of Marcus (1976) does not mention *altus* (or its synonyms as recognised by Bartholomai and Marshall), or *antilopinus*. In the discussion, Marcus (1976) makes comparisons with specimens referred by Marshall (1973) and De Vis (1895) to *cooperi* and suggests there is probably overlap between De Vis's sample (included in Bartholomai's work as *altus*) and *stirtoni*. Further, Marcus (1976) has clearly shown that modern *Osphranter* is sexually very dimorphic in absolute size, and it is not inconceivable that a preponderance of one sex only in any of the very small fossil samples could significantly affect the mean measurements of the whole sample.

All of this indicates the folly of attempting here to positively identify the fragmentary Texas *Osphranter* specimens. It seems entirely possible that the *altus* populations could represent a larger Pleistocene population of *robustus*, in the same kind of relationship as that which exists between *Macropus (M.) titan* and *M. (M.) giganteus*. The

intermediate size of the Texas specimens might then be seen as part of the continuous variation between *altus* and *robustus*.

Modern *Macropus (Osphranter)* species prefer rocky hillsides in a wide range of vegetation habitats. *M. (Osphranter) robutus* is living today on Viator Hill (e.g. JM2247).

Macropus (Macropus) titan
(Plate 8M)

As in the case of the larger *Macropus (Osphranter)* species, there are problems involved in identifying fragmentary remains of the larger *M. (Macropus)* species. Most of the Texas Caves material appears to fall within the size and character range of *M. (M.) titan,* and compares well with specimens from the *titan* sample of the eastern Darling Downs. Bartholomai (1975) indicates that there is overlap in many features

between *M. titan* and *M. giganteus,* but the extent of this overlap is reasonably well-documented by large samples, unlike the case of the *M. (Osphranter) altus-robustus* problem noted above. On the basis of this documentation (Bartholomai 1975), most of the Texas specimens noted below would fall outside the range of modern *M. giganteus,* but not all of them. A few are noted below as *M. (M.) sp.,* cf. *M. (M.) giganteus.*

F8431, a LP[2] from the Bone Chamber of Russenden (rear) Cave, is probably the best single reason for recognising *Macropus (Macropus) titan* in the Texas Caves material. It compares very well with *M. titan* specimens (e.g. F4274, F4235, F4552, and F4252) from the eastern Darling Downs in size and morphology, even to the extent of possessing a small posterobuccal cusp on the flank of the crown. It only differs in that the posterior width (7·5) is slightly wider than other specimens measured (6·4 – 7·2).
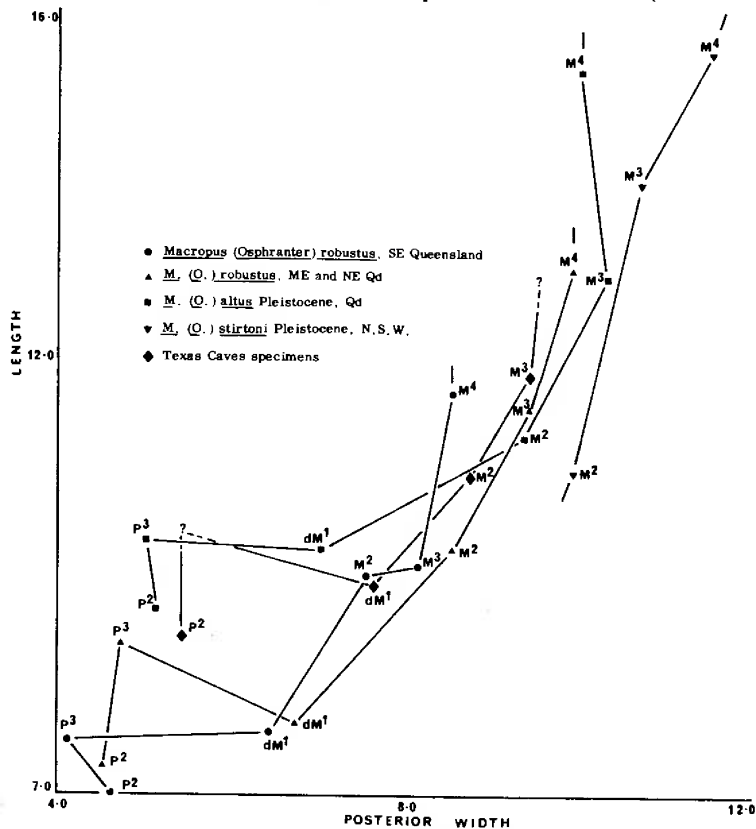

FIG. 7: Comparison of the mean lengths and widths (mm) of P[2] to M[4] in various eastern Australian modern and fossil populations of *Macropus (Osphranter)* species, based on data summarized in Table 7. The fossil samples are small *(altus,* 1–3; *stirtoni,* 1; and Texas, 1–3 individuals). The Texas specimens have been tentatively referred to *M. (O.) sp.,* cf. *M. (O.) altus* on the basis of the similarity of the anterior region of the cheektooth row (see text).

TABLE 7: Crown Dimensions of P²–M⁴ in Two Modern and Three Fossil Samples of *Macropus (Osphranter)* from Eastern Queensland and New South Wales.

Parameter		P²L	P²AW	P²PW	P³L	P³PW	dM¹L	dM¹AW	dM¹PW	M²L	M²AW	M²PW	M³L	M³AW	M³PW	M⁴L	M⁴AW	M⁴PW
M. (O.) robustus southeastern Queensland	x̄	7·0	3·7	4·6	7·6	4·1	7·7	6·0	6·4	9·4	7·2	7·5	9·6	8·0	8·1	11·6	8·7	8·5
	N.	11	11	11	10	10	11	11	11	11	10	10	10	10	10	10	10	9
	O.R.	6·2–7·9	3·3–4·0	4·3–4·9	7·0–8·2	3·8–4·3	6·8–8·3	5·7–6·4	5·9–6·9	8·8–10·2	6·7–7·9	6·9–8·4	9·2–10·1	7·5–8·6	7·4–8·8	11·1–12·3	8·3–9·2	7·8–9·3
	S	0·45	0·21	0·18	0·45	0·18	0·37	0·22	0·29	0·34	0·36	0·50	0·33	0·37	0·41	0·44	0·36	0·58
	C.V.	6·33	5·64	3·89	5·96	4·36	4·86	3·64	4·56	3·63	4·92	6·68	3·43	4·70	5·03	3·80	4·07	6·75
M. (O.) robustus mideastern Queensland	x̄	7·3	4·0	4·5	8·7	4·7	7·8	6·1	6·7	9·8	8·0	8·5	11·4	9·2	9·4	13·0	10·2	9·9
	N.	3	1	2	15	13	2	2	2	8	8	8	13	13	13	15	15	13
	O.R.	7·1–7·6	4·0	4·3–4·6	7·8–9·5	4·1–5·2	7·5–8·0	6·0–6·2	6·6–6·7	9·4–10·4	7·2–8·9	7·9–9·5	10·5–12·5	8·3–9·5	8·7–10·2	11·7–14·6	9·5–10·7	9·0–10·6
	S	0·28	—	0·21	0·49	0·29	0·35	0·07	0·07	0·40	0·54	0·47	0·57	0·34	0·43	0·87	0·42	0·45
	C.V.	3·87	—	4·77	5·59	6·14	4·56	1·15	1·06	4·10	6·76	5·51	5·01	3·65	4·62	6·72	4·10	4·51
Texas Caves specimens	x̄	8·8	—	5·4	—	—	9·4	7·1	7·6	10·7	8·1	8·7	11·8	9·3	9·4	12·9	—	—
	N.	3	—	3	—	—	1	1	1	1	1	1	1	1	1	1	—	—
	O.R.	8·4–9·2	—	4·9–5·8	—	—	9·4–	7·1–	7·6–	10·7–	8·1–	8·7–	11·8–	9·3–	9·4–	12·9–	—	—
M. (O.) altus (Bartholomai 1975)	x̄	9·1	—	5·1	9·9	5·0	9·8	—	7·0	11·1	—	9·3	12·9	—	10·3	15·3	—	10·0
	N.	1	—	1	2	1	1	—	1	3	—	3	3	—	2	1	—	1
	O.R.	9·1	—	5·1	9·8–10·0	5·0	9·8	—	7·0	10·7–11·4	—	9·2–9·4	12·6–13·3	—	10·0–10·5	15·3	—	10·0
M. (O.) stirtoni (Marcus 1976)		—	—	—	—	—	—	—	—	10·7	—	9·9	14·0	10·3	10·7	15·5	11·2	11·5

Two of the dentary specimens (e.g. F8899 and F8412), referred here to *Macropus (M.) titan* are difficult to distinguish confidently from *Macropus (Osphranter)* species, such as *M. (O.) ferragus*. Bartholomai (1975) notes in the diagnosis of the subgenera only one feature which enables separation of dentaries of *M. (Macropus)* and *M. (Osphranter)*, but no dental features. The single feature is the narrower more excavated width of the dentary immediately below the anterior end of the cheektooth row. In practice, this is a difficult character to use, and there is overlap. Additional features used here to separate lower cheekteeth of *M. (M.) titan* and *M. (M.) giganteus* from *M. (Osphranter) ferragus*, include the smaller size of *Macropus*, the relatively lower height of the anterior cingulum of the molars, and the better-developed pocket in the posterior face of the hypolophid. These characters are noted within the text of Bartholomai's (1975) revision.

Measurements are as follows: (Bone Chamber) F8899, M_{2-5}, 53·7; M_2L, 9·5; M_3L, 12·1; M_3AW, 9·0; M_3PW, 10·0; M_4L, 15·1; M_4AW, 9·8; M_4PW, 9·7; M_5L, 18·1; M_5AW, 10·7; M_5PW, 9·9; F8431, P^2L, 9·6; P^2AW, 5·6; P^2PW, 7·5; (The Joint) F8862, P_2 (alveoli) – M_2, 26·2; M_2L, 10·8; M_2AW, 6·6; M_1L, 10·0; M_1AW, 5·6; M_1PW, 6·8; P_3L, 6·8; P_3AW, 2·5; P_3PW, 4·4; F8412, M_{2-3}, 23·0; M_2L, 9·8; M_2AW, 7·2; M_2PW, 8·3; M_3L, 13·5; M_3AW, 8·8; M_3PW, 9·7; M_4AW, 9·3; M_5PW, 8·9; F8870, M_3L, 14·1; M_3AW, 9·0; M_3PW, 8·2. F8862 closely matches *M. titan* specimens F4193, and F4172 (Darling Downs). F8899 closely matches *M. titan* specimens F1651 and F5630 (Darling Downs).

Macropus (Macropus) titan is known from Pleistocene deposits of most Australian states except the Northern Territory and Western Australia. Its modern derivatives live in most habitats except the arid desert areas. *M. (M.) giganteus* is still living on Viator Hill (e.g. JM1862).

Macropus (Macropus) sp., c.f. M. (M.) giganteus
Shaw
(Plate 8L)

Some specimens from the Bone Chamber, Russenden (rear) Cave, have the characters of *Macropus (Macropus)*, but are too small to be placed within *M. (M.) titan*. None appear to represent the Pleistocene *M. (M.) rama* on the basis of the diagnostic characters given by Bartholomai (1975). This leaves several modern species such as *M. (M.) rufogriseus, M. (M.) parryi* and *M. (M.) giganteus*, among Queensland

species, and several additional large species known from other areas of Australia. No attempt has been made here to compare these non-*titan* Texas *M. (Macropus)* specimens with the smaller species of this subgenus simply because they are too large. They closely approximate *M. giganteus* in size and morphology but cannot be confidently referred to this species because they could also represent the morphologically very similar *M. (M.) fuliginosus*, which today although not known from Queensland, occurs as far east as western New South Wales.

Measurements are as follows: F8304, P_3L, 7·4; P_3PW, 3·8; F8514, M^3L, 13·5; M^3AW, 9·9; M^3PW, 9·8; F8514, M^xL, 13·3; M^xAW, 9·7; M^xPW, 9·8.

Macropus (Macropus) giganteus is living today on Viator Hill (e.g. JM1862, and skull picked up on surface, JM1089).

Bartholomai (1975) regards *Macropus (Macropus) titan* and *M. (M.) giganteus* to be successional species of each other, anticipating that a better fossil record will make it increasingly difficult to recognize diagnostic characters that will separate the two. Marshall (1973) regards *M. giganteus* to be the result of late Pleistocene dwarfing of *M. titan* populations. The occurrence of *M. (M.) sp. cf. M. (M.) titan* and *giganteus* in the Russenden (rear) cave deposits (both in the LP layer) might raise some doubts about this interpretation. A similar situation occurs in the Cement Mills fauna (Bartholomai 1977). In both cases some doubt must first be raised about the actual contemporaneity of the two forms. In the case of the Cement Mills deposit, there is other evidence (the two extremes of *Sarcophilus* size, and the two species of *Palorchestes*) to suggest that more than one fauna is involved. In the case of the Pleistocene Bone Chamber specimens, evidence for significantly different faunas has not been recognized. However, as was noted in the discussion of the stratigraphy of the Bone Chamber, this area of the cave has had a complex history. It is possible that specimens in this deposit represent significantly different ages, although this would be the only evidence for such an interpretation. Alternatively, and perhaps more realistically, some of the specimens regarded here to be *M. (M.) sp., cf. M. (M.) giganteus* may in fact merely represent small individuals of *titan*. Whatever the true situation, I do not think the variables involved in the Texas Caves situation are well enough understood to use this as a test area for hypotheses relating to the relationships of those two taxa.

PLACENTALIA

CHIROPTERA

Texas caves specimens identified here have only been compared with modern Queensland bats. In all cases, the specimens could be exactly matched in size and dental morphology with bats living in southeastern Queensland. For this reason, more extensive comparisons with non-Queensland bats were not made, and it is therefore possible, although improbable, that morphologically identical non-Queensland bats might be represented by some of the fossils.

RHINOLOPHIDAE

Rhinolophus megaphyllus Gray
(Plate 8N)

This species was the most common bat fossil in the Bone Chamber, as well as in adjacent caves. In the main chamber of Russenden Cave, three specimens were collected (F8906-8) that have a modern appearance, and the species has been col'ected live from caves on Viator Hill. It seems probable that this species has survived in the area since at least late Pleistocene times.

Measurements are as follows: F8258, M_{1-3}, 5·0; F8542, $C_1 - M_3$, 7·7; M_{1-3}, 5·0; F8268, $C_1 - M_3$, 8·3; M_{1-3}, 5·1; F8939, M_{1-3}, 4·9.

VESPERTILIONIDAE

Nyctophilus timoriensis (Geoffroy)
(Plate 8O)

Only one specimen, F8141, represents this bat from the sediments of the Bone Chamber. It has not been collected live from the Viator Hill area, although this area is well within its extensive modern range in Australia. At least one specimen is known from Stanthorpe, southeastern Queensland.

Measurements as follows: F8141, $P_3 - M_2$, 5·2; M_{1-2}, 3·6.

Miniopterus schreibersii (Kuhl)
(Plate 8P)

Eight specimens from the Bone Chamber of Russenden (rear) Cave represent this Bent-wing Bat. Main Viator Cave was evidently a maternity cave for this species and several modern specimens have been collected from the Texas Caves area.

Evidently, as in the case of *Rhinolophus megaphyllus,* this species has survived in the area since at least the late Pleistocene.

Measurements are as follows: F8152, M_{1-3}, 4·3; F8143, M_{1-3}, 4·3; F8146, M_{1-3}, 4·4; F8153, M_{1-3}, 4·4; F8144, M_{1-3}, 4·4; F8150, M_{1-3}, 4·4.

MURIDAE

Rodent specimens were identified by J. Mahoney. Most species names used here have been listed as similar to (i.e., cf.) the modern species names. This reflects the uncertainties involved in identifying murids on the basis of the fragmentary fossil remains. However, in each case, the fossils could not be differentiated from more complete modern specimens of the species to which they were referred (J. Mahoney, pers. comm.).

PSEUDOMYINAE

Conilurus albipes (Lichtenstein)
(Plate 9C)

Of all murid remains in the Texas Cave deposits, those of the White-footed Tree-rat are the most common. This is in direct contrast to their apparent rarity within historic times, with only two modern specimens in Australian museums and not many more in European museums. Gilbert obtained one specimen from an unspecified locality on the Darling Downs. Gould (1863) suggests it occurred widely throughout its inland range wherever there was tree-growth, the animals nesting in hollow limbs of large eucalypts. The abundance of this otherwise rare animal in the caves of Viator Hill prompted an extensive survey of the depauperate small mammal fauna of the area, but despite the opening of innumerable hollow logs and spouts of eucalypt trees destined to be flooded, no trace of any small mammal was found. Evidently here, as is generally assumed to be the case throughout Australia (e.g. Ride 1970), this rodent has become extinct.

Pseudomys sp., cf. P. oralis Thomas
(Plate 9F)

This species of *Pseudomys* is uncommon in the Texas cave deposits. It was collected live in 1969 from the ranges east of Warwick, southeastern Queensland, and is at present not known to be living elsewhere in Queensland (Covacevich 1974), although it ·occurs in a limited area of northeastern New South Wales. The recorded

habitat is flood debris along creek beds in Eucalypt forest, with dense ground cover.

Pseudomys sp., cf. **P. desertor** Troughton
(Plate 9E)

This species was originally collected from sand dune and spinifex country in the Northern Territory, and subsequently from the more arid inland areas of Western Australia and northern South Australia, in the vicinity of the junction of the Murray and Darling Rivers. It has not previously been recorded from Queensland, although J. Mahoney (pers. comm.) notes that a modern specimen (J4214) was collected in 1925 from Lake Galilee in central western Queensland. Presence of this species in the Texas Caves deposit is unexpected, and either indicates that the habitat requirements of the species were wider than the previously known distribution suggests, or that there was formerly a relatively xeric habitat in the vicinity of Viator Hill. Against the latter alternative, is the absence in the Texas caves faunas of other arid-adapted mammals such as *Macrotis, Chaeropus, Dasycercus,* and so on.

Pseudomys sp., cf. **P. desertor** or **P. gracilicaudatus** (Gould)
(Plate 9D)

Specimens from the Bone Chamber listed under this category in Tables 8 and 9 are not clearly referable to *Pseudomys* sp., cf. *P. desertor*

because they share characters with *P. gracilicaudatus,* but are similarly not clearly referable to *P. gracilicaudatus.* However, specimens from the surface of Rabscuttle Cave (e.g. F8926) are more certainly referrable to *P. gracilicaudatus.*

Mahoney and Posamentier (1975), Covacevich (1975), and Borsboom (1974) review information about this species. It is known to occur live in southeastern Queensland (T. Kirkpatrick, pers. comm.). Open forest is a recorded habitat for the species, and is present today on Viator Hill.

Pseudomys sp., cf. **P. novaehollandiae** (Waterhouse)
(Plate 8R)

This tiny murid was reasonably common in the LP unit of the Bone Chamber of Russenden (rear) Cave. It has not previously been recorded from Queensland, although it occurs today as far north as the north coast of New South Wales (Posamentier and Recher 1974).

Habitats recorded for the species include dry sclerophyll forest with a sclerophyllic understorey, a vegetation type still present on areas of Viator Hill.

At Port Stephens, N.S.W., Posamentier and Recher (1974) found this species in association with the native species *Rattus lutreolus, R. fuscipes,* and *Sminthopsis murina,* all of which are also present in the Texas caves deposits.

TABLE 8: MEASUREMENTS OF MOLAR ROW LENGTH AND M^2 WIDTH FOR TEXAS CAVES MURIDS (A = M$^{1-3}$ LENGTH; B = M^2 WIDTH; C = M$_{1-3}$ LENGTH; D = M$_2$ WIDTH).

Parameter	*Conilurus albipes* (Bone Chamber)				*Pseudomys* sp., cf. *P. oralis* (Bone Chamber)				*P.* sp., cf. *P. desertor* (Bone Chamber)			
	A	B	C	D	A	B	C	D	A	B	C	D
$\bar{x}$	9·8	2·8	9·8	2·9	7·3	2·2	7·0	2·1	5·8	1·9	5·4	1·7
N.	9	19	25	26	3	4	4	5	1	2	1	1
O.R.	9·4– 10·4	2·6– 3·0	9·0– 10·6	2·7– 3·1	7·2– 7·4	1·9– 2·3	6·8– 7·2	2·0– 2·1	5·8	1·8– 1·9	5·4	1·7
S	0·33	0·13	0·45	0·17	0·12	0·19	0·17	0·05	0	0·76	0	0
C.V.	3·33	4·72	4·56	5·73	1·59	8·70	2·75	2·15	0	3·82	0	0

	P. sp., cf. *P. gracilicaudatus* (all)				*P.* sp., cf. *P. novaehollandiae* (Bone Chamber)				*Rattus* sp., cf. *R. lutreolus* (Bone Chamber)			
	A	B	C	D	A	B	C	D	A	B	C	D
$\bar{x}$	5·8	2·0	6·0	1·9	4·1	1·1	4·2	1·2	7·3	2·5	—	—
N.	1	1	2	2	1	1	5	6	2	3		
O.R.	5·8	2·0	6·0	1·9	4·1	1·1	4·0– 4·6	1·1– 1·3	7·0– 7·5	2·3– 2·6	—	—
S	0	0	0	0	0	0	0·24	0·08	0·04	0·02	—	—
C.V.	0	0	0	0	0	0	5·66	6·62	4·88	6·19	—	—

Rattus sp., cf. R. lutreolus (Gray)
(Plate 8Q)

This murid is uncommon in the Texas Caves deposits as are all species of *Rattus*. It is common in most of eastern Queensland (Covacevich 1974) in moist areas in closed and wet sclerophyll forests. It is possible that it may have maintained populations in the wet grassy areas adjacent to Pike Creek, a bend of which surrounds Viator Hill. Its rarity in the deposits suggests a suitable habitat may not have occurred actually on Viator Hill. Living individuals have been collected at Warwick.

Rattus sp., cf. R. fuscipes (Waterhouse)
(Plate 9G)

This species is also uncommon in the cave deposits, but a very common rat throughout eastern Australia, particularly in wet sclerophyll forests. As in the case of the *R.* sp., cf. *R. lutreolus* specimens, the rarity of specimens of this species in the Texas Caves deposits suggests that the habitat for this normally very common rat was not actually on Viator Hill, but rather closer to the moister margins of Pike Creek.

Rattus rattus (Linnaeus)

Rattus rattus (F9454) was collected from the surface of the main chamber of Russenden (rear) Cave. This widespread species has established populations throughout Australia, in a great variety of habitats. It is possible it reached the area at the time of European settlement in the middle of the nineteenth century.

DISCUSSION

SUMMARY OF TEXAS CAVES FAUNAS

Table 9 is a list of the taxa reported above which were recovered from the Joint breccia, and the sediments of the Bone Chamber, Russenden (rear) Cave.

The Joint fauna clearly differs from that of Russenden (rear) Cave, mainly in being more impoverished. All of the reasons for this are not clear but certainly must include the different collecting techniques. The Joint fauna was obtained by hand-breaking lumps of breccia, whereas the Russenden (rear) Cave fauna was largely obtained by sieving, a more efficient technique for recovery of small mammals. The probably older age of the Joint fauna, as discussed below, would further account for some of the differences in species in the two deposits.

There is some, albeit meagre, evidence for faunal development within the Russenden (rear) Cave sequence. Comparing the LP with the UB samples and its lateral equivalent (not including UBP, which may be younger than UB, see above; or 0–20, which is clearly a mixed sample), some species appear to have delined up through the deposit (e.g. *Sminthopsis murina)* and others to have increased in abundance (e.g. two of the bat species). However, the minimum numbers of individuals in all samples, except the 0–20 cm sample, are too small to conclude anything meaningful about unit differences.

The diversity of the Russenden (rear) Cave fauna is probably reasonably representative of the mammal fauna actually living on and around Viator Hill at the time of its accumulation, interpreted below to be late Pleistocene. No group of expected mammals is unrepresented, and some are represented by more species than occur in southeastern Queensland modern faunas. Numerous mammalian taxa represented have either become completely extinct (e.g. *Sthenurus* sp., *Protemnodon roechus, Macropus agilis* aff. *M.a. siva, M. titan, Conilurus albipes, Sarcophilus laniarius,* and possibly *Antechinus* sp.), or regionally extinct from southeastern Queensland *(Dasyurus viverrinus, Isoodon obesulus, Pseudomys desertor,* and *P. novaehollandiae).* Others are extremely rare in southeastern Queensland *(Cercartetus nanus)* or not now known in southeastern Queensland to occur in habitats presently found on Viator Hill *(Perameles nasuta, Thylogale* sp., and *Rattus lutreolus).* The remainder include species which, on the basis of known habitat requirements, could be expected to have been found living on Viator Hill at the time of European settlement *(Sminthopsis murina, Antechinus flavipes, Phascogale tapoatafa, Vombatus* sp., *Acrobates pygmaeus, Petaurus* sp. (possibly only *P. breviceps,* see discussion above), *Pseudocheirus peregrinus, Trichosurus vulpecula, Aepyprymnus rufescens, Petrogale* sp., *Macropus dorsalis, Pseudomys oralis, Nyctophilus timoriensis,* and *R. fuscipes),* or which were encountered live on Viator Hill during these investigations (e.g. *Macropus giganteus, M. robustus, Rhinolophus megaphyllus,* and *Miniopterus schreibersii).*

PALAEOENVIRONMENTS

The majority of species recorded from The Joint breccia are indicative of a dry to wet sclerophyll forest habitat. The possible exceptions are *Thylogale* sp. and *Perameles nasuta,* which

TABLE 9: MINIMUM NUMBER OF INDIVIDUALS OF MAMMALS IN THE JOINT AND RUSSENDEN (REAR) CAVE FAUNAS

Taxa	Joint fauna	Russenden (rear) Cave faunas							
		LP	LPW	UB	UBW	UBP	UBPW	0–20 cm	total (R)
Sminthopsis murina	0	3	0	2	1	0	0	16	22
Antechinus sp., aff. A. flavipes	0	0	1	1	2	0	0	6	10
Antechinus sp.	0	0	0	0	0	0	0	1	1
Phascogale tapoatafa	0	1	0	0	0	0	0	1	2
Dasyurus viverrinus	0	1	0	0	2	0	0	3	6
Sarcophilus laniarius	1	0	0	0	0	0	0	0	1
Thylacinus cynocephalus	1	0	0	0	0	0	0	0	0
Perameles nasuta	1	1	1	0	1	0	0	2	5
Isoodon obesulus	1	0	0	0	0	0	0	1	1
Vombatus cf. V. ursinus	1	0	0	0	0	0	1	1	2
?Zygmaturus sp., cf. Z. trilobus	1	0	0	0	0	0	0	0	0
Cercartetus nanus	0	0	0	0	0	0	0	2	2
Acrobates pygmaeus	0	0	0	1	0	0	0	0	1
Pseudocheirus peregrinus	0	0	1	0	0	0	0	1	2
Petaurus breviceps	0	0	0	0	0	0	0	1	1
P. norfolcensis	0	1	0	0	0	0	0	2	3
?Trichosurus sp., cf. T. vulpecula	0	0	0	0	0	0	0	1	1
Aepyprymnus rufescens	1	0	1	1	0	1	1	2	6
Genus indet., F8362	0	0	0	0	1	0	0	0	1
Procoptodon texasensis n. sp.	1	0	0	0	0	0	0	0	0
Sthenurus sp., cf. S. atlas	1	0	0	0	0	0	0	0	0
S. sp., cf. S. oreas	1	0	0	?	0	0	0	1	?2
S. sp., aff. S. occidentalis	1	0	0	0	0	0	0	0	0
Protemnodon roechus	1	0	0	0	0	0	0	0	1
P. brehus	1	0	0	0	0	0	0	1	1
Thylogale sp.	2	0	0	0	0	0	0	?	?1
Petrogale sp.	4	1	0	1	4	1	2	1	10
?Petrogale, F8417	0	1	0	0	0	0	0	0	1
Macropus dorsalis	3	1	0	0	0	0	0	0	1
M. sp., aff. M. agilis siva	1	0	0	0	0	0	0	2	2
M. sp., cf. M. thor	2	0	0	0	0	0	0	0	0
M. sp., cf. M. robustus	2	1	0	0	0	0	0	1	2
M. titan	2	1	0	0	0	0	1	1	3
M. sp., cf. M. giganteus	0	1	0	0	0	0	0	1	2
Rhinolophus megaphyllus	0	0	0	0	2	1	1	3	7
Nyctophilus timoriensis	0	0	0	0	0	0	0	1	1
Miniopterus schreibersii	0	0	0	0	1	0	0	4	5
Conilurus albipes	1	4	4	1	0	1	3	25	38
Pseudomys sp., cf. P. oralis	0	0	1	1	0	?	0	2	?5
P. sp., cf. P. desertor	0	0	0	0	0	?	1	2	?4
P. sp., cf. P. novaehollandiae	0	5	0	0	0	0	0	0	5
P. sp.*	1	0	1	0	0	?	0	3	5
Rattus sp., cf. R. lutreolus	0	0	0	0	0	0	0	2	2
R. sp., cf. R. fuscipes	0	0	1.	?	0	0	0	1	?3

*P. sp. = P. desertor or P. gracilicaudatus

although known from wet sclerophyll forests, are more commonly found in rainforests, at least in southeastern Queensland. Unfortunately, some of the more environmentally sensitive smaller species are unknown from The Joint, larger species being more common. The preferred habitat of the sebecosuchian crocodile might be assumed to be water, evidence supporting the reasonable probability that Pike Creek was then, as it is now, adjacent to Viator Hill.

The Bone Chamber faunas include many small species, most of which support the concept of a dry to wet sclerophyll forest habitat. Exceptions include *Pseudomys* sp., cf. *P. desertor* which is today indicative of dry, semi-arid to arid habitats, and *Perameles nasuta*, ?*Thylogale* sp., *Rattus* sp., cf. *R. lutreolus* and even *R.* sp., cf. *R. fuscipes* specimens, which on the contrary suggest a wet sclerophyll or possibly rainforest habitat. In each case, the aberrant species are very uncommon, and this could be interpreted in at least two ways: either the habitats of these animals were remote from the immediate area of Viator Hill; or these species were occupying non-preferred habitats and hence present in low numbers.

COMPARISONS OF PLEISTOCENE QUEENSLAND FAUNAS

Table 10 presents summary faunal lists for the four largest southeastern Queensland Pleistocene faunas: the Cement Mills fauna (Bartholomai 1977); the eastern Darling Downs (no general summary has previously been made, but the extensive revisionary works of Bartholomai on the kangaroos from these deposits consider the majority of known taxa); The Joint fauna; and the Russenden (rear) Cave faunas.

There are absences of whole groups from all of these faunas. Direct comparisons are limited by what are presumably problems of selective fossilization, such as the apparent absence of bats in the eastern Darling Downs, Cement Mills, and Joint faunas. There is also the probability that there were different habitats in the particular areas examined. For example, nothing in the eastern Darling Downs fauna suggests an arboreal habitat; on the contrary, the extraordinary abundance of grazing and browsing kangaroos suggests the Pleistocene Darling Downs was much as we see it today, a vast grassland habitat with patches of shrubs suitable for the browsers. The Cement Mills fauna also contains many grazing kangaroos, but it also possesses some forest species such as *Phascolarctos stirtoni, Perameles nasuta, Vombatus ursinus,* and *Potorous* sp., aff. *P. tridactylus.* In still greater contrast to the eastern

Darling Downs, are The Joint and Russenden (rear) Cave faunas which have a high proportion of species indicating a forest habitat.

Despite these overall differences, these faunas are more similar to one another than any is to non-Queensland Pleistocene faunas, with the possible exception of the Wellington Caves and Bingara faunas of New South Wales. Many of the kangaroos, diprotodont and wombat species present in these New South Wales faunas also occur in the deposits of the eastern Darling Downs.

NOTABLE ABSENCES FROM OR RARITIES IN THE FAUNA

Compared with other eastern Australian Pleistocene faunas in Australia, some absences in the combined Joint-Russenden species list (Table 9) are of interest. Only one wombat species appears to be represented, and of particular interest is the absence of *Phascolonus gigas* which is normally present in the better-known Pleistocene faunas. Possibly the forested limestone hillside habitat was unsuitable for species other than *Vombatus* sp., cf. *V. ursinus,* whose remains were not uncommon in the Russenden (rear) Cave.

Only *Zygomaturus* sp., cf. *Z. trilobus,* of four possible late Pleistocene diprotodontoids, is represented. Absence of the other three may reflect their unwillingness to walk across slopes with jagged limestone projections. Comparison can be made with the Wellington Caves, which contain at least two of the three non-Texas diprotodontoids and many of the wombats. The difference in character of the exposed limestone of the two areas is marked. At Wellington the limestone outcrops around the caves have rounded edges. On Viator Hill, the limestone weathers into sharp karst structures, with a vertical relief in some areas of as much as a metre. The intervening depressions are filled with tall grasses. Movement through this type of country would almost certainly have been avoided by the larger herbivores if they could bypass the hill on the adjacent riverine floodplain soils.

The apparent absence of *Thylacoleo carnifex* is not so easily understood, although it could be the result of a chance sampling error.

Trichosurus vulpecula, the common Brush-tailed Possum, was found on the surfaces of many of the Texas Caves, but only a single tooth appears to represent this species from the excavated deposits. This rarity in the older deposits is unexpected compared with the abundance of the species today in most areas of Australia. Perhaps

TABLE 10: COMPARISON OF MAMMALS PRESENT IN SOUTHEASTERN QUEENSLAND PLEISTOCENE FAUNAS

Cement Mills	Eastern Darling Downs	The Joint	Russenden (rear) Cave
—	—	—	Sminthopsis murina
—	—	—	Antechinus flavipes
—	—	—	A. sp.
Dasyurus aff. D. viverrinus	D. viverrinus	—	Phascogale tapoatafa
Sarcophilus sp.			D. viverrinus
(S. sp., large)			
Thylacinus cynocephalus	S. laniarius	S. laniarius	S. laniarius
Perameles nasuta	T. cynocephalus	T. cynocephalus	
Isoodon obesulus		P. nasuta	P. nasuta
Phascolarctos stirtoni	—	I. obesulus	I. obesulus
Vombatus ursinus			—
Phascolonus gigas	?	V. ursinus (hirsutus)	V. ursinus (hirsutus)
P. cf. P. magnus	P. gigas		—
	P. magnus		—
—	P. medius*		—
?Zygomaturine	Zygomaturus trilobus	Z. trilobus	—
Nototherium inerme	N. inerme		
Palorchestes azael	Diprotodon optatum	—	Cercartetus nanus
P. parvus	P. azael		Acrobates pygmaeus
Thylacoleo carnifex		—	Trichosurus vulpecula
—	T. carnifex		Petaurus norfolcensis
—		—	P. breviceps
—			Pseudocheirus peregrinus
—		—	
Potorous aff. P. tridactylus	—		
Aepyprymnus rufescens	A. rufescens	A. rufescens	A. rufescens
Bettongia sp.			
Sthenurus oreas	S. oreas	S. sp., cf. S. oreas	S. sp., cf. S. oreas
—		S. sp., cf. S. atlas	—
—	S. andersoni	S. sp., aff. S. occidentalis	—
—	S. pales		—
—	S. orientalis	—	—

TABLE 10 Continued: COMPARISON OF MAMMALS PRESENT IN SOUTHEASTERN QUEENSLAND PLEISTOCENE FAUNAS

Cement Mills	Eastern Darling Downs	The Joint	Russenden (rear) Cave
Procoptodon sp., cf. P. texasensis	—	P. texasensis	—
—	P. rapha		
—	P. goliah		
—	P. pusio		
Protemnodon anak	P. anak		
P. brehus	P. brehus	P. brehus	P. brehus
P. roechus	P. roechus	P. roechus	P. roechus
—	Wallabia indra		
Thylogale sp.	—	Thylogale sp.	?Thylogale sp.
—		Petrogale sp.	Petrogale sp.
Macropus sp., cf. M. agilis siva	M. agilis siva	M. sp., cf. M. agilis siva	M. sp., cf. M. agilis siva
—	M. piltonensis	—	—
	M. gouldi		
M. dorsalis	—	M. dorsalis	M. dorsalis
—	M. thor	M. sp., cf. M. thor	—
M. parryi			
—		M. sp., aff. M. robustus	M. sp., aff. M. robustus
	M. altus		
	M. ferragus		
M. titan	M. titan	M. titan	M. titan
M. giganteus	—		M. sp., cf. M. giganteus
—	M. rama		
—	Fissuridon pearsoni		
—	Troposodon minor		
—			Rhinolophus megaphyllus
—			Nyctophilus timoriensis
—			Miniopterus schreibersii
—		Conilurus albipes	C. albipes
—		Pseudomys sp.*	P. sp.*
—			Pseudomys sp., cf. P. oralis
—			P. sp., cf. P. desertor
—			P. sp., cf. P. novaehollandiae
—			Rattus sp., cf. R. lutreolus
—			R. sp., cf. R. fuscipes
Rattus sp.	—	Rattus sp.	Rattus sp.
—	Homo sp.		

it is possible that the activities of European man, in opening up forested areas, have benefited these opportunistic possums.

AGE OF THE TEXAS CAVES FAUNAS

As noted above, no radiometric dates could be obtained for bone samples from The Joint or Russenden (rear) Cave. For this reason, it is necessary to consider faunal composition in an attempt to understand the relative ages of these faunas.

The Joint contains a greater percentage of extinct taxa than the Russenden (rear) Cave deposits, despite the smaller number of species represented in The Joint. It also contains the sebecosuchian crocodile, a type of animal unknown anywhere else in the world from the Pleistocene. Although this single occurence in The Joint is certainly not an irrefutable reason for regarding them to be older than the Russenden deposits, it contributes to this general conclusion. Finally, as Grimes (1978) points out, The Joint is higher up on Viator Hill than Russenden and, on the assumption that the caves on this hill have been gradually exposed from top to bottom as the ancestral Pike Creek cut down towards its present bed level, The Joint would have been in a position to receive bones long before Russenden (rear) Cave.

The Joint fauna contains many of the same or closely related extinct species characteristic of Pleistocene mammal assemblages in New South Wales (e.g. Wellington, and Bingara). But comparisons of this sort do not yet enable us to place The Joint fauna within a specific part of the Pleistocene. The superpositional faunas from the Lake Victoria area of New South Wales do give some idea of faunal development within the Pleistocene of eastern Australia, although there are no radiometric dates associated with these faunas. Compared with these, most overlap in elements occurs with the late Pleistocene Frenchman's Creek and Lake Victoria faunas.

The Russenden (rear) Cave faunas, although presumably younger than the Joint fauna, are regarded here to be Pleistocene in age because of the presence of *Stenurus* sp., cf. *S. oreas*, two species of *Protemnodon*, *Macropus (Prionotemnus)* sp., cf. *M. (P.) agilis siva*, and *M. titan*. The association of these undoubted Pleistocene species with a mammal microfauna containing rodents, small dasyurids, bats, and small possums, makes this fauna more important as a basis for comparisons with the abundant but as yet largely undescribed Pleistocene small mammal faunas from caves in New South Wales.

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PLATE 7

Mammals from The Joint (VR-5), and Russenden (rear) Cave (VR-14). A: F8344, *Sminthopsis murina*, LC_1–M_5, x2. B: F8286, *Antechinus* sp., aff. *A. flavipes*, LC_1–M_5, x2. C: F8445, *Antechinus* sp., x2. C': occlusal view of F8445, LP_2 and M_{2-5}, x2. D: F8285, *Phascogale tapoatafa*, RC^1, M^{2-3}, x2. E: F8042, *Dasyurus viverrinus*, LM^4, x3. F: F8883, *Sarcophilus laniarius*, LM_2 and roots of P_2, x1. G: F8871, *Thylacinus cynocephalus*, LM_3, x1. H: F8085, *Perameles nasuta*, RM^{2-3}, x2. I: F8086, *Isoodon obesulus*, RM^{2-4}, x2. J: F8027, *Cercartetus nanus*, LP_3–M_3, x2. K: F8206, *Acrobates pygmaeus*, LP_3, x2. L: F8201, *Pseudocheirus peregrinus*, RM^x, x2. M: F8413, *Petaurus breviceps*, RI_1–M_5, x1·5. N: F8203, *Petaurus norfolcensis*, LI_1 and M_{3-4}, x1·5. O: F8898, *Trichosurus* sp., cf. *T. vulpecula*, I_1, x1·5. P: F8240, ?*Zygomaturus* sp., cf. *Z. trilobus*, lingual half of LM^3 hypoloph, x1. Q: F8407, *Aepyprymnus rufescens*, RM_{2-5}, x1. R: F8362, genus indet., ?LM^1 (with protocone missing), x3. S: F7894, *Sthenurus* sp., aff. *S. occidentalis*, RP^2–M^1, x1. T: F8239, *Sthenurus* sp., cf. *S. oreas*, M^x, x1. U: F8380 (LM_{2-4}) and F7895 (LP_3), photographed but not actually found together, *Sthenurus* sp., cf. *S. atlas*, x+1. V: F7947, *Thylogale* sp., RI^3, x2·5. W: F8524, ?*Thylogale* sp., LP_2–M_3, x1. X: F8417, ?*Petrogale* sp., RM_{2-4}, x1. Y: F8526, *Petrogale* sp., RP_2–M_2, half of M_3, and M_4, x1. Z: F8860, *Macropus dorsalis*, RP_2–M_2, x1. AA: F8859, *Macropus* sp., cf. *M. thor*, LM_5, x1. BB: *Macropus* sp., aff. *M. agilis siva*, F9444, RP^2–M^2 (P^3 in crypt), x1. CC: *M. a. siva*, F8923, RM^1, x2. DD: as for CC, but buccal view showing occlusal view of excavated P^3, x1.
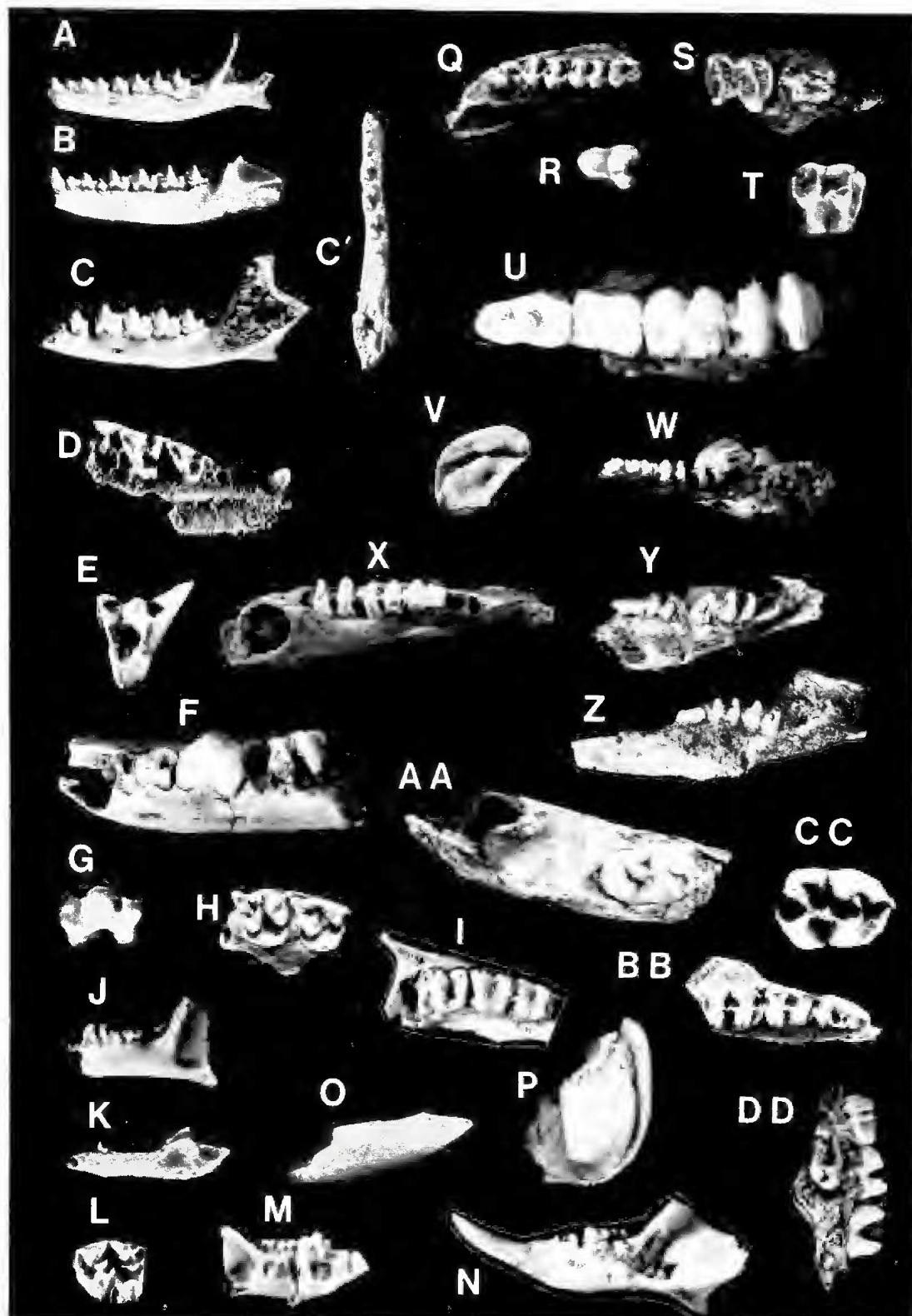
PLATE 8

Mammals from The Joint (VR-5), Russenden (rear) Cave (VR-14), and a non-Queensland specimen of *Procoptodon rapha*. A–A': stereopair, F7894, *Procoptodon texasensis* n. sp., occlusal view of RP^3 (anterior is up), x2. B–B': stereopair, MF956 (Australian Museum), *P. rapha* from the Bingara fauna (Marcus 1976), RP^3, x2. C–C': stereopair F7894, *P. texasensis*, occlusal view of RM^1 (anterior is to the right), x2. D–D': stereopair F7894, *P. texasensis* lingual view RP^3 (anterior is up), x2. E–E': stereopair F7894, *P. texasensis*, RP^3, buccal view (anterior is up), x2. F–F': stereopair MF956, *P. rapha*, RP^3, lingual view (anterior is up), x2. G–G': stereopair MF956, *P. rapha*, RP^3, buccal view (anterior is up), x2. H: F8495 (I^1) and F9464 (I^2) (not found together but interpreted here to be conspecific, see text), *Protemnodon brehus*, buccal view of I$^{1-2}$, x1. I: F8154, *Protemnodon*, cf. *P. brehus*, P^3 fragment, x1. J: F8238, *P. brehus*, RP^3 (anterior is up), x1. K, F7896, *Macropus (Osphranter)* cf. *M. (O.) altus* R and LP^2–M^1, occlusal view (anterior is up), x1. L: F8304, *Macropus (Macropus)* sp., cf. *M. (M.) giganteus*, P$_3$, x2. M: F8431, *Macropus (M.) titan*, LP^2, x1. N: F8258, *Rhinolophus megaphyllus*, LP$_3$–M$_s$, x2. O: F8141, *Nyctophilus timoriensis*, LP$_3$–M$_2$, x2. P: *Minopterus schreibersii*, F8150, x2. Q: F8085, *Rattus lutreolus*, LM$^{1-3}$, x2. R: F8421, *Pseudomys novaehollandiae*, LM$^{1-3}$, x2.
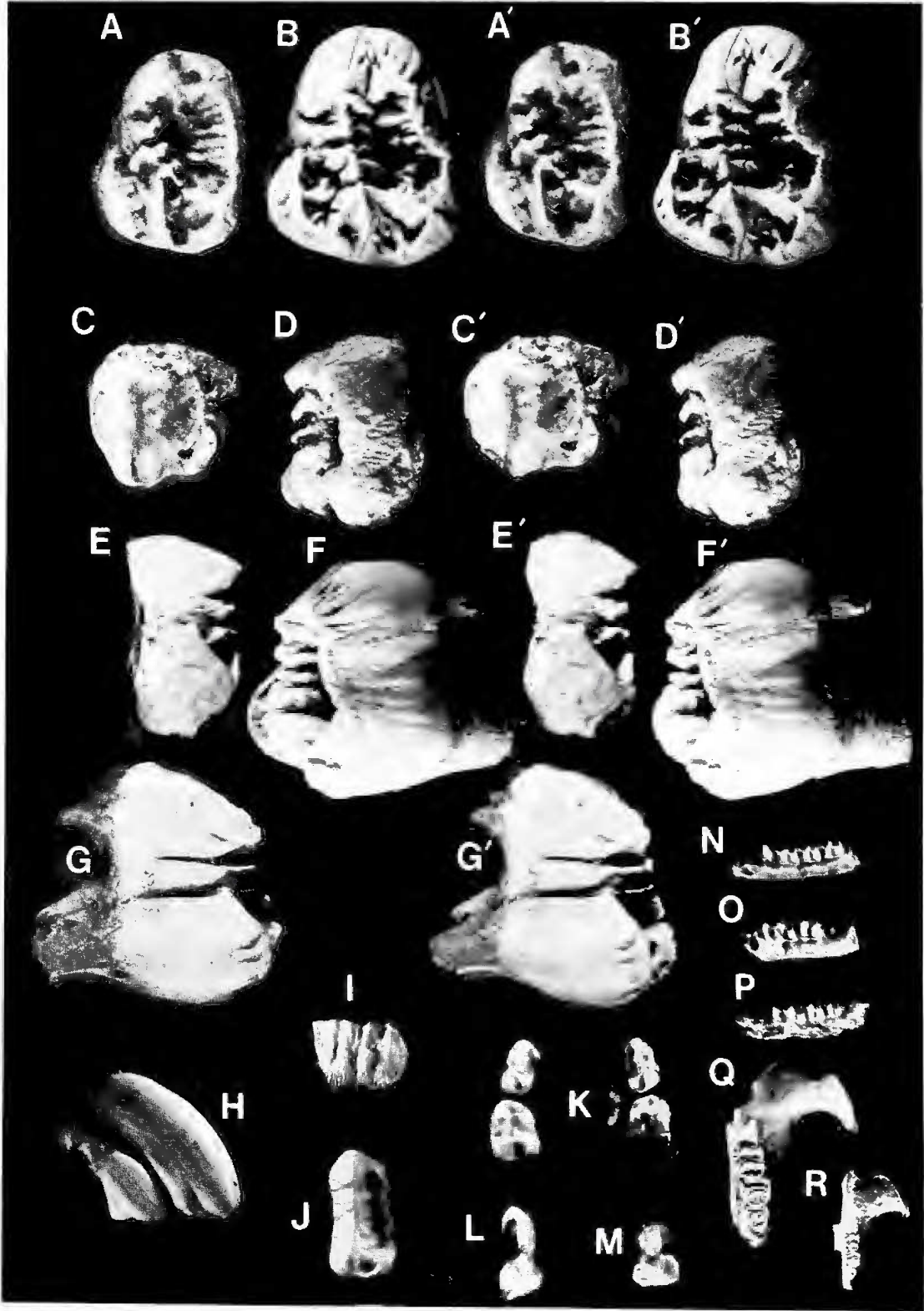
PLATE 9

Mammals from Russenden (rear) Cave (VR-14). A–B: F6132, *Protemnodon roechus*, skull fragment with L and RP^3–M^5, x 0·5. C: F8528, *Conilurus albipes*, skull fragment with L and RM^{1-3}, x2. D: F8926, *Pseudomys* sp., cf. *P. gracilicaudatus* (from Rabscuttle Hole), RM^{1-3}, x2. E: F9453, *Pseudomys* sp., cf. *P. desertor*, RI_1–M_3, x2. F: F8411, *Pseudomys* sp., cf. *P. oralis*, RM_{1-3}, x2. G: F9446, *Rattus* sp., cf. *R. fuscipes*, LI_1–M_3, x2.

Photograph in the Bone Chamber of Russenden (rear) Cave (VR-14) (see Figs. 1–2 for scale). This view is facing the east wall and is taken from within the excavation. Features are as follows: *a*, the crawl space that leads to the main chamber of Russenden Cave (VR-2); *b*, the massive limestone ceiling of the Bone Chamber; *c*, the fracture space between the ceiling and a dropped block of ceiling limestone; *d*, the dropped chunk of ceiling limestone; *e*, flowstone cone, centre of distribution for massive flowstones in Bone Chamber; *f*, massive flowstones capped by more finely laminated flowstones; *g*, blocks of flowstone falling into cavity below; *h*, breccia merging with lower parts of massive flowstone; *i*, less indurated sediments laterally equivalent to UB and LP units (see Fig. 2); *j*, space under flowstone produced either by erosion or compaction of sediments.
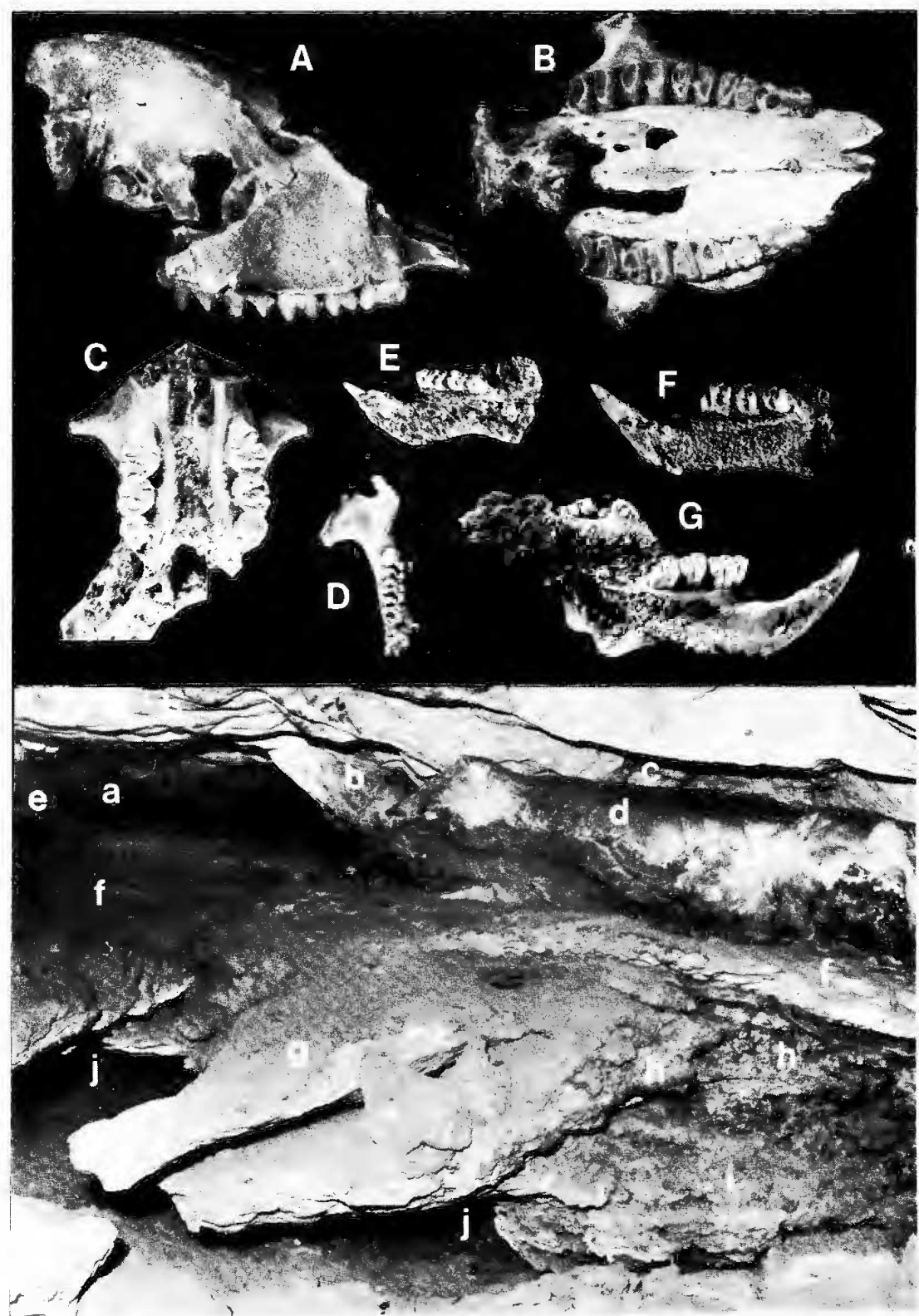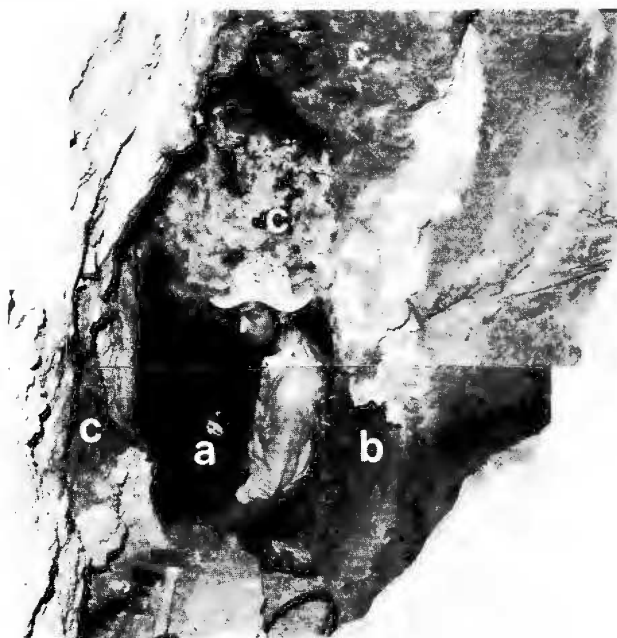
PLATE 9

PLATE 10

The Joint (VR-5). A and B are views of the 'Breccia Keyhole' (see text) after removal of bone breccia from the walls. A is looking southeast; B is looking northwest; C is a horizontal view looking along The Joint itself. The walls are almost vertical. The soil floor (a) appears as the dark strip between the walls. A head (at d) indicates the position of the first keyhole in The Joint, formed in massive limestone. D is a view looking up towards the top of The Joint fissure, past remnant masses of bone breccia. Materials indicated are as follows: *a*, soil floor; *b*, massive limestone walls of The Joint; *c*, bone breccia; and *d*, position of limestone keyhole.

PLATE 10

A

B

C

D